## Windmills for Water Supply.

Written for ENGINEERING NEWS.

BY ALFRED R. WOLFF, M. E.

In one of its summer cartoons, *Puck* pictures a large group of artists in grotesque positions sketching one and the same windmill, and thus conveys pleasantly and strikingly its point that there are dozens of artists to do more or less justice to each windmill in the country. Possibly if we have in mind the old fashioned windmill of the Dutch type which *Puck* portrays, this may literally be the case, but we scarcely imagine that the proportion will hold true, when the distinctively American type of windmill is considered, for of these there are hundred thousands in use in America. Most of them are employed for pumping water, and exceed in economy for this purpose any other motor in the market. We are well aware that these statements will be surprising to many, but they are none the less true on that account. Furthermore, despite an erroneous popular notion that windmills are antiquated, their use is constantly increasing, so that there are single cities in the Union in which thousands are manufactured each year.

It would be interesting to trace the early history of windmills, beginning with the twelfth century, which period authentic records fix as the date of their original use, and show their development unto the present time, when the American type has almost replaced the far more picturesque but less efficient Dutch mill. But our object being one of practical import to point out briefly the construction and the economy of the American windmill for water supply, we must sacrifice the interesting for what, it is hoped, will prove the useful.

Let us then mention among the main adaptations of their use, the supply of country houses and farms, of manufacturing establishments, and of the upper stories of office buildings and domestic dwellings, when the pressure in the reservoir is not sufficient to effect this, the supply of railway water stations and tanks, and the irrigation of lands. Experience has proved that for eight hours per day the windmill will work up to its rated capacity, and if provision is made to have sufficient tank capacity for a three days' water supply, there need be no anxiety of the water giving out, for a calm of two days' duration may be said to be the outside limit in the U. S. The average velocity of the wind, in this country, during the eight hours of running, is about sixteen miles per hour, corresponding to a pressure of 1.2 pounds per square foot of surface.

The receiving surface of the American windmill and the methods employed to regulate the extent offered to the wind, as its force varies, are the distinguishing features of the American type. The transmitting parts are the ordinary crank-wheel and connecting rod, and similar methods of transferring circular into rectilinear motion.

The receiving surface, or "wind-wheel," is made up of a large number of blades or slats of small width, set at an angle into cross bars connecting the arms of the windmill. This construction gives a distinct appearance to the American wheel, since it resembles a closed surface as compared to the large open spaces between the arms of the Dutch mill, though, of course, ample room is provided between the slats to permit the free escape of the impinging air. This division of the receiving-surface of the mill into a large number of narrow sections, which in turn are sustained by truss rods from an extension of the main shaft, enables a much smaller aggregate weight of parts for a desired strength, size and capacity of mill; so that the American windmill is lighter than the Dutch. The angles employed are not as advantageous in the former as in the latter; but the surface presented for a given diameter is so much greater in the American wheel, as to more than compensate for this defect.

No better proof of the superiority of the American windmill need be given than the fact that it is rapidly replacing the Dutch type in Germany, France and England, and that it is being manufactured on a large scale in these countries. In the English colonies, too, the American windmill is being extensively used on the recommendation of English engineers.

The two principal types may be distinguished respectively as the sectional wheel with the centrifugal governor and independent rudder, and the solid wheel with the side-vane governor and independent rudder. In both types, the rudder brings the wheel into the direction of the wind. This rudder is a large strong vane projecting opposite the shaft and the wheel. The plane of the rudder is vertical and perpendicular to that of the wheel; so that the wind, however shifting, acts directly upon the rudder to bring the plane of the wheel normal to the wind.

In the first type, the flying out or receding of weighted arms causes the slats of the wheel to revolve, in sections, on pivots in the windmill arms or frame, thus bringing the slats or the surface of the wheel more or less normally to the direction of the wind. In the second type, there is a vane nearly in the plane of, and directly behind the solid wind-wheel, which vane is attached to the bearing of the shaft. When the velocity of the wind increases, the increased pressure on this side vane causes the wind-wheel to turn bodily away from the wind, the whole wind-wheel and bearing rotating on a horizontal turn-table, which forms part of the support of the mill. Thus, less effective surface is presented to the wind until the wind decreases, when the lowering of a counter-balancing weighted lever, raised previously by the turning of the wheel when the pressure was high, causes the wheel, together with its accompanying side vane, to turn more normally to the wind.

In a third type a solid wind-wheel is employed, but the regulation is effected by placing the rudder, or its equivalent, at a slight angle to the center line of the shaft, so that the wind-mill is never entirely normal to the direction of the wind. As the wind-pressure increases materially, the rudder is thrown more to the side, and the wheel more out of the wind. In a fourth type, no rudder at all is employed, and the pressure of the wind on the wheel itself is relied upon to bring the wheel into the proper direction. These latter two types are not at all sensitive, but answer satisfactorily for smaller mills, to which their use is restricted.

The two leading types of American windmills, manufactured in regula sizes from 8½ feet to 40 feet diameter of wheel, act with sufficient accuracy and promptness to place them in the rank of reliable automatic engines. But even conceding this, it must be shown that they are more economical than other motors employed for pumping water, if the windmill is to be used in preference. Such, however, is the case. That motor may be defined to be the most economical, which develops the desired pumping effect for the least current money expense, including in such expense, the sum of the interest, repairs and depreciation of motive plant, cost of fuel, attendance and the like.

Judged on this basis, and mainly because wind is a free gift of nature, while other motors require fuel, it is found that the windmill is by far the most economical for pumping water in moderate quantities.

The following tables show the capacity and the economy of American windmills of standard make:

Multiplying the figures in columns 6 of the second Table by 584, we obtain the first cost of windmill in dollars.

CAPACITY OF THE WINDMILL.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Designation of Mill. | Velocity of Wind in Miles per Hour. | Revolutions of Wheel. | Gallons of Water Raised per Minute to an Elevation of | | | | | | Equivalent Actual Useful Horse-Power Developed. | Average Number of Hours per Day, during which this Result will be Obtained. |
| | | | | 25 feet. | 50 feet. | 75 feet. | 100 feet. | 150 feet. | 200 feet. | | |
| I | 8½ feet wheel | 16 | 70 to 75 | 6.2 | 3.0 | — | — | — | — | 0.04 | 8 |
| II | 10 feet wheel | 16 | 60 to 65 | 19.2 | 9.6 | 6 6 | 4.8 | — | — | 0.12 | 8 |
| III | 12 feet wheel | 16 | 55 to 60 | 33.9 | 18.0 | 11.9 | 8.5 | 5.7 | — | 0 21 | 8 |
| IV | 14 feet wheel | 16 | 50 to 55 | 45.2 | 22.6 | 15.3 | 11 2 | 7.8 | 5.0 | 0.28 | 8 |
| V | 16 feet wheel | 16 | 45 to 50 | 64.6 | 31.7 | 19.6 | 16.2 | 9.8 | 8.1 | 0.41 | 8 |
| VI | 18 feet wheel | 16 | 40 to 45 | 97.7 | 52.2 | 32.5 | 24.4 | 17.5 | 12.2 | 0.61 | 8 |
| VII | 20 feet wheel | 16 | 35 to 40 | 124.9 | 63.8 | 40.8 | 31.2 | 19.3 | 15 9 | 0.78 | 8 |
| VIII | 25 feet wheel | 16 | 30 to 35 | 212.3 | 107.0 | 71.6 | 49.7 | 37.3 | 26.7 | 1.34 | 8 |

ECONOMY OF THE WINDMILL.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10. | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Designation of Mill. | Gallons of Water Raised 25 feet per Hour. | Equivalent Actual Useful Horse Power Developed. | Average Number of Hours per Day during which this Quantity will be Raised. | Expense of Actual Useful Power Developed, in Cents per Hour. | | | | | Expense per Horse Power in Cents per Hour. |
| | | | | | For Interest on 1st Cost (1st Cost Including Windmill, Pump and Tower) 5 % per Annum. | For Repairs and Depreciation (6 % of 1st Cost) per Annum. | For Attendance. | For Oil. | Total. | |
| I | 8½ feet wheel | 370 | .04 | 8 | 0.25 | 0.25 | .06 | 0.04 | 0.60 | 15.0 |
| II | 10 feet wheel | 1151 | .12 | 8 | 0.30 | 0.30 | " " | 0.04 | 0.70 | 5.8 |
| III | 12 feet wheel | 2056 | .21 | 8 | 0.36 | 0.36 | " " | 0.04 | 0.82 | 3.9 |
| IV | 14 feet wheel | 2708 | .28 | 8 | 0.75 | 0.75 | " " | 0.07 | 1.63 | 5.8 |
| V | 16 feet wheel | 3876 | .41 | 8 | 1.15 | 1.15 | " " | 0.07 | 2.43 | 5.9 |
| VI | 18 feet wheel | 5861 | .61 | 8 | 1.35 | 1 35 | " " | 0 07 | 2.83 | 4.6 |
| VII | 20 feet wheel | 7497 | .79 | 8 | 1.70 | 1.70 | " " | 0.10 | 3.56 | 4 5 |
| VIII | 25 feet wheel | 12743 | 1.34 | 8 | 2.05 | 2.05 | " " | 0.10 | 4.26 | 3.2 |

Tables calculated on same basis for steam pumps, hot-air, gas engines and the like, show conclusively that to obtain the same moderate pumping effects by means of these motors, according to special circumstances of use, costs from 2½ to 10 times as much as when windmills are employed. Accordingly, it will be good practice to extend the introduction and use of windmills, especially for domestic, railway and farm water supply.

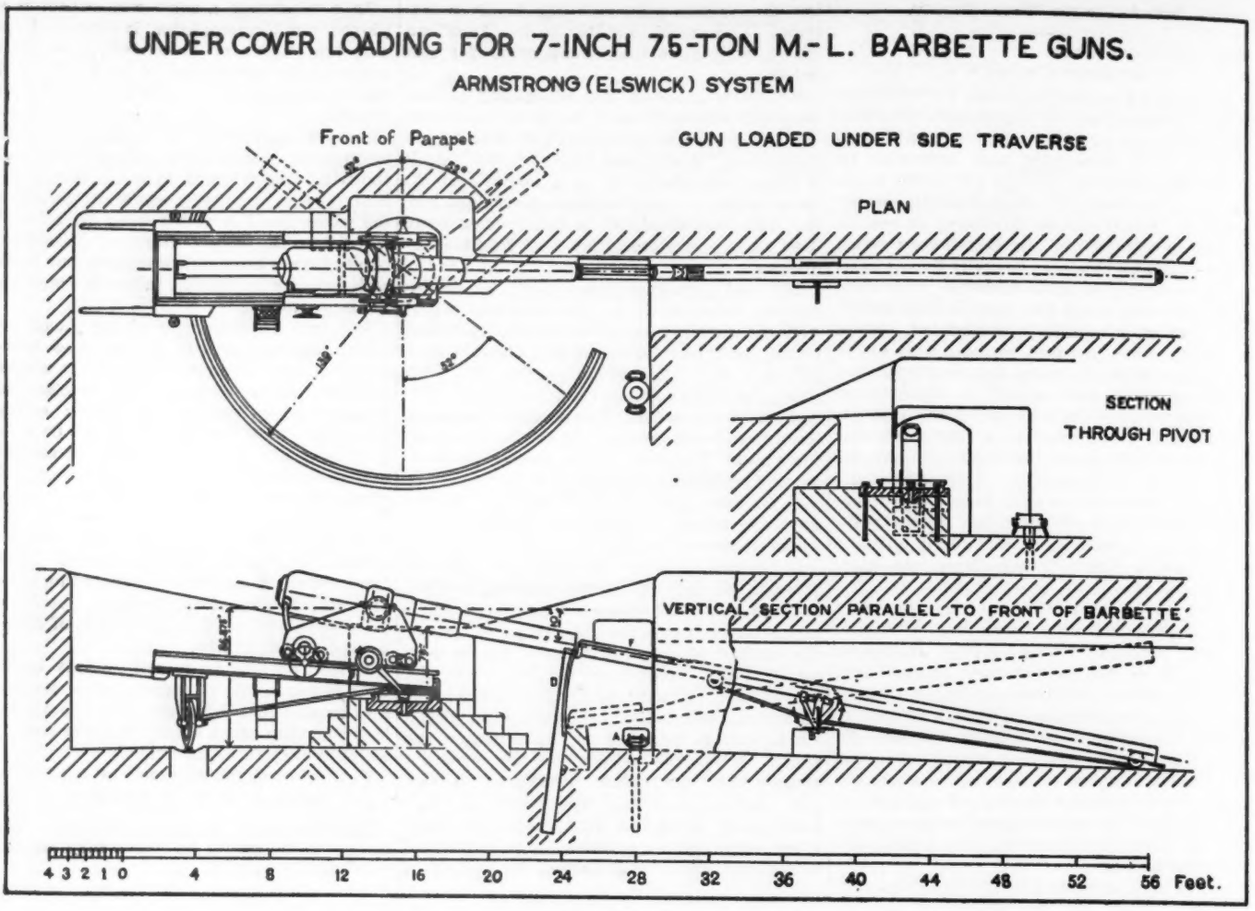
UNDER COVER LOADING FOR 7-INCH 75-TON M.-L. BARBETTE GUNS.
ARMSTRONG (ELSWICK) SYSTEM
Front of Parapet
GUN LOADED UNDER SIDE TRAVERSE
PLAN
SECTION THROUGH PIVOT
VERTICAL SECTION PARALLEL TO FRONT OF BARBETTE
4 3 2 1 0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 Feet.

PLATE No. 10.

## NEW ORDNANCE MATERIAL.*

**Official Report to the U. S. War Department.**

BY WM. H. BIXBY, CAPT. OF ENG'S., U. S. ARMY.

(*Continued from page 341.*)

**English Official Systems of Under-Cover Loading.**

The following quotation from pages 181, 182, Vol. 7, Royal Engineers Professional papers for 1882, will show what is being done in this direction officially in England:

"*Rear loading for 38-ton guns.*—In order to remedy this exposure of the men while loading and also with a view to get increased rapidity of fire by giving the men more room to work in, a plan was tried at Cliff End Battery of turning a 38-ton gun to the rear to load. A fixed stage, or 'loading pillar,' was built against one of the merlons, carrying a cast-iron trough on which the shot was deposited by means of a davit. The traversing gear of the gun was altered to allow of its being worked from the level of the sunken way, the tail of the drum being cut away so that there should be no interference with the traversing gear in any position. When it was required to load, the gun was turned round to the rear, sponged out, and the cartridge entered, and then turned to the trough and depressed to 8 degrees. The shot was then rammed home in the ordinary manner, but the men having plenty of room were able to work with greater freedom.

The results were so satisfactory that it was determined to have a fresh trial with additional modifications. The loading trough is to be enlarged so as to contain both the shot and cartridge in readiness for the gun; the traversing gear is to be worked from a fixed winch in rear of the gun, the power being taken to the platform by means of shafting, and the elevating, pointing and firing is to be done from the sunken way under the chase of the gun. In order to permit of the gun being fired without inconvenience to a man in this position, the radius of the emplacement has been reduced by 3 feet.

To carry out these proposals an alteration of the elevating gear has to be made, reflecting sights fitted and an electric firer devised. The No. 1 of the gun will then have the power of following every movement of an object and of firing the instant he wishes.

If these alterations are successful the rapidity of fire will be increased; the gun detachment will be always under cover, except (for a short time) the man who serves the vent and primes; and the aiming will be much improved. In fact the barbette mounting of a 38-ton R. M. L. gun in a *C* pivot emplacement will be really satisfactory.

*Under-cover loading generally.*—It remains, however, to deal with all the other heavy service R. M. L. guns which are mounted "*en barbette.*"

For these it has recently been decided to alter the traversing gear of the guns mounted on *C* pivot racers, so as to enable it to be worked from the level of the sunken way, and to load from behind the traverses, the shot being placed in an iron trough on a 'loading pillar' in readiness to be rammed home, in a similar manner to the first experiment with the 38-ton gun, but with a modification which will enable the rammer to be always in position for use.

This involves making the drums circular and constructing the fixed loading pillars.

It has not been thought expedient to incur the expense that would be involved in making arrangements for elevating or aiming from under cover.

These alterations will evidently much improve the security of the detachments. They have not yet been actually tried, but will be shortly.

It can, however, I think, be already laid down that the service R. M. L. guns, arranged for under-cover loading, will not be able to fire over a larger arc than 160 degrees, and that a space of 30 feet on either side of the pivot should be allowed for working a 10-inch gun; rather more for a 12.5-inch, rather less for a 9-inch. It follows from this that it is not every emplacement that can be altered for under-cover loading.

It may be observed from the reduction in the size of the drum from which the gun is fired will render very solid building necessary, or it will be shaken and displaced by the shock of recoil.

R. M. L. guns mounted on *D* pivot racers cannot be treated in this way; luckily there are very few of them, other than 9-inch. A pivot emplacement must, I think, either be converted to *C* pivot or shielded, if additional protection be required.

*Sir W. Armstrong's protected barbette.*—A system of under-cover loading, which has been worked out by Sir W. Armstrong for long R. M. L. guns, and which has been used by some governments, is about to be tried at Shoeburyness. The essential part of it is a long pivotted trough, in which lie the charge and the rammer, and which is sheltered from fire by the parapet or is placed in a loading chamber.

The gun is turned to one side and depressed to load, and the charge raised to the muzzle by pivotting the trough; it is then rammed home by working a winch, from which the power is communicated to the rammer by a wire rope.

A further description of it in its present stage might prove of small value, while, at the same time, one cannot forecast the alterations that may be made in it. There are

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however, three characteristics that can hardly be changed, and which must affect any decision as to its employment; they are the following:—the emplacement, with the rammer chambers, must cover a great deal of ground; it must be very difficult to give it efficient protection against enfilade fire; and the accuracy of the fittings must be extreme, or the loading arrangements will fail to act."

**Armstrong's Systems of Under-Cover Loading.**

During the writer's visit to Elswick in 1881-82, these systems were fully explained to him, and he had an opportunity of seeing how the hydraulic apparatus was manœuvred. The hydraulic portion of this system is almost identical with that used for turret guns on ship-board on the Colossus, Inflexible, and Thunderer. Most of these arrangements are the invention either of Sir William Armstrong or of Mr. Rendel, and have been fully described by the latter in a lecture before the Institution of Civil Engineers in London in 1873-4.[1] Its application to barbettes is as follows:—

The *Armstrong "barbette" system of protected side-loading for small* 7-inch 7.5 ton M.—L. *guns* on front pintle carriages is fully shown in the accompanying drawing (Plate 10). It will be there seen that the barbette is lowest opposite to the center of the gun, and rises on each side towards the traverses. After the gun has been fired, its muzzle is slightly raised and the gun is then turned around until it is parallel to, and wholly behind the front parapet's interior crest; when the gun has reached this position, it can be depressed till its muzzle is opposite the loading trough in the passageway under the side traverse. The relative advantages and disadvantages of this arrangement are self evident, when this form of mounting is studied from its drawings and photographs.

The *Armstrong "barbette" system of protected side-loading for large* 100-ton M.—L. *guns under side traverses* is well shown in the upper figure of Plate 11.[2] The whole service of the gun in this case, for elevating, traversing, loading and arresting recoil, is all hydraulic; and is almost the same as if the gun were mounted in a turret. The ammunition is placed on a car in the loading rooms below, rolled to the ammunition lift, raised by hydraulic power, and rammed to place (as in the Inflexible.

The Armstrong "barbette" system for similar 100-ton M.-L. guns on barbettes *without traverse* (as at Malta and Gibraltar) is fully shown in the lower figure of Plate 11. In this case two iron cages take the place of the passages under traverses.

The following description by Capt. Orde-Browne[3] explains the system better than any other description as yet heard or seen by the writer.

"This is the largest example of a muzzle-loading gun, firing 'en barbette' and loaded under cover by bringing it round parallel to the parapet, on the system advocated by Mr. George Rendel. The principle of keeping the center of gravity of the mass nearly over the traversing center is observed, while the employment of the gun as an inclined plane for running the shot up to its seat in the bore is applied to considerable purpose in the case of a projectile weighing 2,000 pounds. It may be seen in the figure that the gun can be loaded with less exposure of men than in the case of a breech-loader. The gun itself would be a difficult object to strike from a point far below, such as the deck of a vessel engaging with the 100-ton guns at the Ragged Staff Battery at Gibraltar, or the battery between

[1] See pages 85 to 132 (several plates), Vol. 38, Proc. Inst. Civ. Engrs. 1873-4 (this article is one of the most valuable and interesting of its kind yet published.

[2] From Encyclopedia Brittanica, article "Gunnery."

[3] Both the figure and description are taken from the London *Engineer*, of 24th September, 1880, and July, 1881.

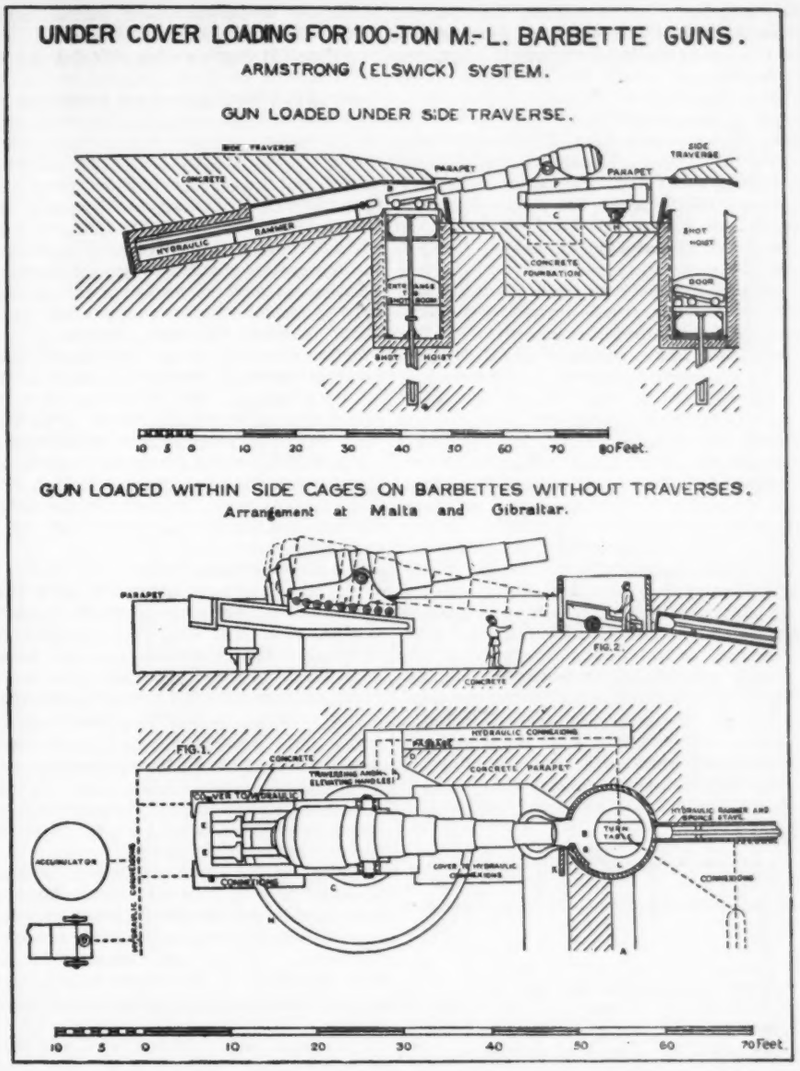


PLATE No. 11.

Sliema and Tigne at Malta, from 70 feet to 90 feet above the sea level, nor would it be very feasible from a vessel to injure the detachments by curved fire."

The gun was mounted and tested at the proof butts at the Royal Arsenal, Woolwich, on September 12th and 22nd, 1880. "It was fired first on Monday, September 12th, on which occasion only a single round was discharged. On last Wednesday, September 22nd, two more rounds were fired. The gun being discharged into the butts, the chief object of the trial is the working of the hydraulic gear by which the gun is traversed and loaded, the behavior of the piece on its carriage, and the convenience of the battery arrangements generally. The gun is mounted on a traversing platform, as shown in the figures, so as to fire 'en barbette' over a concrete parapet from 7 feet 6 inches to 8 feet high. This represents the battery in which the piece will be eventually mounted, whether at Malta or Gibraltar, in the former station we believe in the battery known as the Ragged Staff, and at the latter in positions one on each extremity of the harbor works, the western one at a point between Sliema and Tigne of as great command above the sea-level as can be secured, and at the east on a considerably higher point. The battery in the Arsenal is made to represent the conditions sufficiently to enable the trial to be carried out satisfactorily. It will be seen in plan that the gun and carriage traverse on circular racers H H, on a firm foundation of over 3,000 tons of concrete. The weight of the gun and carriage and platform is 152 tons. The mounting is on the same general principle as that adopted on board ship, but of course differs considerably in the carrying out. In a revolving turret no provision for traversing the gun is necessary, consequently the gun may be made to move with its trunnions held in small blocks sliding on the fixed slide. Here the traversing platform has to replace the movement of the turret. The gun carriage is, however, kept low and small, moving freely on eighteen trucks, and along the lower edge of each bracket, as in the figure; and the recoil is controlled by hydraulic buffers fixed as little below the axis of the trunnions as may be. On board, to prevent the rolling of ship moving the gun, it is always necessary to employ toothed wheels and cogged arcs. On land all this is simplified, plain trucks and racers being used. Hence on land traversing becomes comparatively easily provided for and effected, and hence muzzle-loaders, moving into a certain position to receive their charge, have a much better chance of holding their own against breech-loaders than on board ship, as may be seen from the fact that this gun could be traversed through 180 degrees in fifteen seconds, and it is hoped that it can be loaded and fired at the rate of one round in about two minutes.

In both figures the gun is traversed in the direction for loading—that is, it is pointed with its muzzle towards the loading hole of an iron cylindrical chamber or "cage" *B*. In its position on the works of Malta or Gibraltar there would be two such cages at opposite sides of

the traversing circle of the gun. The concrete parapet extending from *B* past *D* represents the parapet extending from cage to cage, over which the gun would fire, traversing to the nearest cage to load. The gun has to be elevated to fire immediately over the loading cage, but it becomes clear of it by traversing through 17 degrees. Hence its available arc of working and firing to sea is 180 degrees—34 degrees = 146 degrees. The accumulator and engine here shown will be down below the ground level at Malta and Gibraltar. The gun moves very smoothly and easily at the rate we have said, namely, through 180 degrees in about 15 seconds, when worked by the accumulator and hydraulic gear supplied. The accumulator has a weight of about 71 tons. It is here worked by an ordinary steam sapper of 6-horse power, working only at 70 pounds to the inch. It can also be pumped up by forty men with hand pump gear, in which case it is calculated that the gun can be fired at about the rate of one round in 7.5 minutes, while if man power is employed without an accumulator it can fire one round in about fifteen minutes. The general directions of the hydraulic gear connections are shown in the plan. Traversing, elevating, and depressing is effected by moving a handle at *D*, washing and loading by a handle near *L* in the cage. The magazines and shell rooms are designed to be below ground, the projectile and charge being lifted on a truck and run into the cage, and brought round on the turntabl and presented towards the muzzle of the gun. The loading hole is habitually kept closed by two covers. The noise and shock inside the cage must be considerable when the gun is fired n early over it.

Col. Inglis, R. E., however, made trial of it himself on one of the first rounds fired in the Royal Arsenal to ascertain if there was any serious objection to be ma le on this score. The hinged cover *K* is not considered satisfactory and is to be replaced by another. The sliding cover *G* appears to work well. The muzzle of the gun is depressed till it rests in a curved iron support set in concrete, seen in the plan, when its axis is at an angle of depression of 11 degrees—not shown in elevation. A bolt is shot out from the cage above it, and thus it is held steady for loading. In the sliding cover *G* is a fixed pipe, from which water is violently ejected up the bore, so as to wash it. The sponge head, which also is used for a rammer, is forced up the bore. This is fixed on a wooden shaft, about 6 inches in diameter, and about 50 feet long. It is free to turn on its axis, and when sent home by hydraulic pressure, follows the spiral course of the grooves. After sponging, the cartridge and projectile are run on to the turntable, turned, and forced home. The charge is made up of two cartridges, the rear one having a wooden tube forming a passage from end to end, so as to enable the flash from an axial vent to pass through it and ignite the front end of the rear cartridge, and rear end of the front one, a small annular primer being employed to facilitate ignition. The charge employed on Wednesday was 441 pounds of *P*.2 powder: 425 pounds had been employed on September 12th. The shot was a proof cylinder, weighing 2,000 pounds, with a gas check on the base. Sponging and ramming home, each appears to occupy about 20 seconds time at present. The gun was fired by an ordinary electric tube but it is intended to close the vent completely in firing eventually.

The first round fired on Wednesday was not in all respects satisfactory. The working and action of the gun was all that could be wished, but the velocity was only 1040 feet. The pressure was not, we believe, sufficient to be recorded, and the recoil was only 2 feet 8 inches. On the 12th a velocity of 1,520 feet was obtained, and a recoil of about 4 feet 6 inches. It was conjectured that the projectile must on Wednesday have slipped forward again after ramming home, the angle of depression of 11 degrees being sufficiently abrupt for this to be likely to happen with a clean bore. After loading the next round the bore was carefully felt, to make sure such an occurrence had not again taken place. On firing, a velocity of 1,556 feet per second was obtained, and the carriage recoiled 4 feet 7.5 inches the weight of charge and projectile being the same as in the previous round, 441 pounds and 2,000 pounds respectively. This bears out the supposition that the projectile slipped forward in the previous round; indeed, it is the only apparent means of explaining the velocity obtained. Of course the use of a wad would prevent the projectile from moving—a contingency which, it may be observed, would be more likely to arise in the case of a tight fitting sponge, which might have some power of suction in the movement of withdrawal.

The working of the gun is very satisfactory, and most striking as to its smoothness, speed, and apparent ease. It is wholly the work of Elswick, and the design, we presume, of Mr. G. Rendel."

The above-described arrangement can evidently be so arranged as to give all requisite protection to every one except the man who aims the gun. The only serious objection to its use, is that each emplacement for a single gun, with its two cages and two rammer chambers, must cover a great deal of ground.

### Manoeuvre of Heavy Guns.

The hand service of heavy guns has not changed very much during the last few years.

The steam service of heavy guns has made considerable progress, and its most important recent application is to the "Admiralty Pier Turret," at Dover, England.

The hydraulic service, however, of heavy guns has rapidly risen into public favor and great prominence all over Europe. This rapid progress seems due almost entirely to the zeal and energy of the Armstrong works, who have supplied the hydraulic apparatus for almost all the guns and turrets of modern war vessels.

This steam and hydraulic service, with its hydraulic rammer and water jet sponger, are merely modifications of the methods suggested by Mr. Stevens, of Hoboken, worked out in detail by Mr. Holley, and actually practised by Mr. Stevens with a 10-inch gun in 1862. (See pages 589 to 593, Holley, Ordnance and Gunnery, New York and London, 1865.)

Almost all the various devices for simplifying the service of heavy guns by either hand steam or hydraulic power, have been described in full detail in a report of the writer on "Turrets," to be published by the U. S. Government during the coming winter. All that is necessary for a fair understanding of the subject can be found interestingly stated in the article on "Gunnery" in the last edition of "Encyclopedia Britannica." Other still fuller and valuable details can be found in the works mentioned below.

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TO BE CONTINUED.

## Reminiscences of the Construction of the New York, West Shore & Buffalo Railroad.*

BY WM. H. SEARLES, MEMBER OF THE CIVIL ENGINEERS' CLUB OF CLEVELAND.

[Read May 12, 1885.]

The project of a railroad along the western shore of the Hudson river was a favorite one for many years before it was finally realized in the splendid property now known as the New York, West Shore & Buffalo Railroad. Up to the year 1872, although several schemes had been started and companies organized for the purpose of building a railroad between Hoboken and Albany, no more progress had been made than to drive lines of stakes in preliminary surveys and to construct maps and profiles of locations on paper, in which the imagination of the draughtsman was allowed full play. Rival companies vied with each other in planting their stakes and their bonds, but no practical good came of either.

The New York, West Shore & Chicago Railroad Company was incorporated on the 13th of July, 1870, in the State of New York, to build and operate a line of railway from the state line of New Jersey on the Hudson to a point on the Niagara River. The New York & Fort Lee Railroad Company, of New Jersey, was authorized to build a railroad from Hoboken to the state line of New York, but transferred its rights and franchises by lease dated July 26, 1871, to the New York, West Shore & Chicago Railroad, so that the latter corporation became empowered to build and operate a railroad from Hoboken to Buffalo. John M. Courtenay was the president of the company and Gen. Charles B. Stuart engineer-in-chief. Both these gentlemen are now deceased. The plan of the route in its general location and in the character of its grades was due to the eminent engineering ability of Gen. Stuart, who was the originator and chief promotor of the scheme.

During the year 1872, ten corps of engineers, numbering twelve men each, were placed in the field to locate the line between Hoboken and Buffalo. On the 1st of February of that year the writer was appointed Chief Engineer of the Seventh Corps, and assigned to the most difficult portion of the line, the High-

*From the Journal of the Association of Engineering Societies; September, 1885.

lands of the Hudson, including Fort Montgomery, Cozzen's Rock, West Point and Storm King and extending to Blue Point, nearly opposite Poughkeepsie.

The prominent points of the Highlands rise directly from water 80 to 100 feet deep, at an angle of about 67 degrees to the horizon, great masses of granite, towering to heights varying from 250 to 1,400 feet above tide. The indentations of the shore present, in some instances, rock no less precipitious, though here the water was comparatively shallow at the shore, the bottom consisting of a thin layer of soft black silt upon a hard clay which descended at a slope of about 4 or 5 to 1 to the channel bank of the river, where it went off suddenly into deep water at a slope of 30 or 40 degrees.

It was the fixed policy of Gen. Stuart to avoid the use of tunnels, excepting at West Point; hence the location resulted in side cuttings on bluff points, wide enough to accommodate the entire roadbed, and in embankments across the bays, sufficiently removed from the channel bank, as was believed, to prevent slipping. At the same time it was the aim of the engineer to equalize the cuts and fills as far as might be with curves limited to four degrees, and a grade perfectly level, 12 feet above low-water mark. The rise of the tide is about 4 feet.

At the outset a preliminary survey was made with extraordinary care, by which were determined all the features of the shore, and cross sections were taken above and below water. The inaccessible points were passed on the ice, which was then firm, and the slope angle observed. As the location could only be studied on paper, the preliminary survey was plotted at 100 feet to the inch, and the contours drawn at every 5 feet (sometimes oftener) above and below low-water mark. After the location had been projected on these maps a set of notes for the field was made from them, noting all crossings of the preliminary and located lines, and the offsets from one to the other at every instrumental point. By means of these notes the location was placed on the ground after the ice had disappeared; not continuously, of course, but in patches at accessible places, depending for continuity on the accuracy of the preliminary. As there was seldom earth enough on the rock to hold a stake, the stations and other points were secured by short plugs of iron let into holes drilled in the rock and projecting half an inch or more. Long stakes were used to mark the stations in the water. The line was then leveled, sounded and cross-sectioned, and a profile made of the centre line and side lines of the proposed roadbed. This profile had a horizontal scale of 100 feet to an inch. An estimate was finally prepared, and this, together with reduced maps and profiles of about 30 miles, were submitted by the 1st of July, 1872, five months from the start, one month, however, having been employed by the seventh corps in locating through Erie county and running a preliminary through Ontario and Seneca counties. Further study suggested some changes in the line, which were made chiefly to throw it more inshore where it seemed to be too near the channel bank.

The U. S. Military Reservation, including the post of West Point, extends along the river about 2½ miles from a point a little below West Point Landing northerly to a point near "Cro' Nest," opposite the village of Cold Spring. No right of way, in the ordinary sense of that term, could be obtained across this reservation, but by an Act of Congress passed February 16, 1869, the then existing "West Shore & Hudson River Railroad Company" was authorized to pass through these lands by consent of the Secretary of War under such conditions as he might see fit to impose. When this old company was absorbed by the New York, West Shore & Chicago Railroad Company, all its rights and franchises came into the possession of the latter, including the right to cross the reservation. The Secretary of War in 1872 demanded that West Point should be passed by a tunnel, to avoid disturbing the picturesque beauty and seclusion of the shore at this historic spot. It is probable, however, that the tunnel would have been driven in any case, as the alignment is thereby much improved.

The company completed its location and its land maps in 1872, acquired some right of way, and purchased some terminal property; but no construction was accomplished beyond excavating the approaches to the tunnel, and doing a little ordinary grading at three or four points where it seemed advisable to secure the located line against rival companies. Notwithstanding the fact that the company began the year with some $3,000,000 in its treasury, the funds seemed to be nearly exhausted by the close of the year. The remnant of the engineer corps was discharged January 1, 1873, with one or two exceptions, and the company became bankrupt soon after, even the office furniture being seized and sold for debt. The panic which followed in September cast its black pall over the corpse, and the project seemed to be, for many years, beyond the hope of resurrection.

At length, in 1880, after many stormy meetings of the bondholders of this and prior companies, a new organization was effected, which is the present New York, West Shore & Buffalo Railroad Company. An arrangement to build that part of the river line lying between Haverstraw and Cornwall was made with the New York, Ontario & Western Railroad Company as a part of its through line to New York City. Walter Katté, Esq., was chief engineer of this company. The writer was made division engineer in charge of this work, and of the branch from Cornwall to Middletown, for the Ontario Company; also of the river line from Cornwall north to the Ulster county line, for the North River Construction Company. Having carefully preserved all the original maps, profiles, sections and field notes of his former location along the river, he was now able to bring these at once into service, and thus to prepare the line for the contractors' operations very much sooner than would otherwise have been possible. The iron plugs of the former survey were readily found and identified, having stood guard over the line for eight years. The old location was generally adopted on the river division, except that some of the side cuttings were made heavier, and fills lighter. The policy of avoiding tunnel work was adhered to.

The plan of construction contemplated placing the rock from the cuts in the fills in the usual manner, but this could not always be done. Some side cuts were so long and so deep that time could not be spared to excavate from the ends only, so that when a foothold had been secured by blasting a path along the upper limit of the cutting the level ledge so formed was worked down to grade, quarry fashion, the rock being blown directly into the river by hundreds and thousands of yards. Even when it was desired to save the material, great difficulty was experienced in preventing the rock from being thrown overboard by the force of the blast, so narrow was the roadbed compared with the depth of the cuts. It was found necessary to appoint inspectors of blasting to prevent the contractors from making a general waste. From Dunderberg to Storm King there was no cutting in any material but solid rock worth mentioning, except at Target Hill, and no place where a borrow pit could be made except at one point known as the "Slide."

The clay bottom of the river bays proved itself in some instances a treacherous foundation for the embankments. Apparently hard and firm, it would support the rock filling for some weeks or even months, and then in some places it would suddenly slide upon the smooth bedrock, carrying the embankment with it down and out to the river channel, leaving the water on the located line considerably deeper than before. Sometimes a second bank built upon the rock, and having the first bank for a support at the toe, would be permanent; in other cases bank after bank would slip away, leaving no recourse but to change the line to avoid the insatiable holes. These changes of line involved over 80,000 cubic yards additional rock cutting and a considerable amount of sharper curvature. There was one such hole on the south side of Storm King apparently of so small extent in the beginning that it was thought there would be a superabundance of rock in the cut to fill it; but persistent dumping for six months failed to make any embankment show above the water, and the line was thrown a little deeper into the mountain, and a four-degree curve replaced by a ten before the roadbed could be formed.

At Cranston's is a pocket in the rocky shore that no amount of material would fill. It was finally bridged by two spans, one of 135 feet and one of 89 feet. In place of a pier between the spans, a heavy iron girder projects from the cliff in the form of a bracket bolted to the rock, a drawing and description of which is published in the *Railroad Gazette*, of May 11, 1883. The writer lays no claim to this design. In this bridge the west truss is over the shore while the east truss is over water 80 or 100 feet deep. There is a similar case at Fort Montgomery, where a little bay extending two hundred feet along shore lies between two rock-cuts, one of them very heavy. The center line was on shore, but the rock would not fill the half roadway over the water. A dock builder proposed to build a crib here and anchor it to the shore. He did so; and when his work was nearly completed at a cost of some $10,000, the structure took French leave, and was afterwards discovered to have lodged 500 feet from shore in water 100 feet deep, where it now rests in company with the great chain of revolutionary fame. The gap is now spanned by a handsome iron bridge in one span.

Near Buttermilk Falls a rock-cut had been taken down to grade, the entire road-bed resting on the cut, when the half-bed next the river slipped down and disappeared. Of course, the only remedy was to work the cut over again, beginning at the top, 75 feet above the grade, and taking off about 16 feet. At Storm King the cutting was 90 feet deep on the upper side, at Hampton 125 feet deep, all in the solid rock. Yet the greatest difficulty encountered was not so much in the cuts as in certain fills near them, as already explained.

It now seems to be pretty well proved that the policy of adopting a surface line along such a bold and rugged shore was an unwise one. The amount of rock excavated is very much greater than would have resulted from the adoption of a line with a few short tunnels, so much so as to overbalance the increased cost of tunnel work per cubic yard. A tunnel line would have less curvature than the original location, and this advantage is still more apparent when compared with the present line distorted as it now is, under the exigencies of the case in a number of places, by sharp and sometimes reversed curves. A tunnel line would have avoided all the difficulties of slipping embankments, being so much more in shore, while the tunnel material would have made such banks as were required without waste. As all the tunnels would have been in apparently solid, self-sustaining rock, the contingency of delay and increased expense could not have been so great as in placing heavy embankments on

the treacherous river bottom, and the line might have been earlier opened to traffic. Added to these advantages is the no mean one of exemption from the danger to passing trains of snow slides and falling rocks from the mountainous heights.

Before work could be resumed at West Point it was necessary to obtain further legislation from Congress. A new bill was passed empowering a Commission of West Point officers to prepare, subject to the approval of the Secretary of War, the conditions upon which permission would be granted the company to begin operations on the reservation. The Commission took good care that the Government should not be a loser in the transaction, and greatly increased the conditions over those imposed in 1872. The company, having no option in the matter, complied with them all. Among these may be mentioned the construction of a new pier at the steamboat landing, as the old one was going to decay; the providing of an extensive system of sewers for the houses and roads on the north side of the post; the filling up to grade of the entire bay north of the post, included between the railroad and shore; the preserving of the target ground for the "seacoast battery" by diverting the line of the railroad from the shore of Target Hill to a ravine behind it, from which, in order to gain the river front again, it was necessary to make a cutting through the spur 140 feet deep and 450 feet wide on top, containing 435,000 cubic yards of gravel and hardpan, and, finally, the building of an astronomical observatory near Fort Putnam at a cost of not less than $50,000. The material was taken from Target Hill by steam shovels, and hauled by trains from each end of the cut to fill the bay as required.

The work of constructing the line through the Highlands was begun in June, 1880, and was about completed in December, 1882, covering a period of two years and five months.

The cost for graduation and masonry was about as follows:

On the section from Fort Montgomery to West Point, 4.52 miles, $290,000, or $64,400 per mile; on the section from the U. S. Reservation to Cornwall, 3.34 miles, $255,000, or $76,500 per mile; on the U. S. Reservation, 2¼ miles (including the West Point Tunnel, 1 mile), $750,000, or say $333,300 per mile.

Thus 10.11 consecutive miles cost for graduation and masonry alone about $1,295,000. To this sum must be added the cost of an exceedingly expensive right of way, and of tracklaying and bridging, besides all the incidental expenses of a great and difficult work.

The first train ran from Middletown to West Point on January 8, 1883. The first regular passenger train ran through from Jersey City to Newburgh on June 4, 1883, and this portion of the road was declared open for business on that day.

## New Method of Making Conventional Signs on Original Topographical Maps.*

BY J. A. OCKERSON, M. AM. SOC. C. E.

(Read at the Annual Convention, June 26, 1885.)

The use of characters, rather than colors, to represent on maps the different kinds of vegetation, soil, etc., has mainly been restricted to maps issued by the General Government. The principal reasons for this have doubtless been that the former, being hand work, was too expensive, and required too much time for general use; and, furthermore, draughtsmen skilled in this class of work are quite rare. No system of colors can give as satisfactory a representation of the surface features of the section mapped as can be obtained by a proper use of conventional characters.

If it is desired to reproduce the originals by photo lithography or analogous processes, the latter style is far more economical.

*From the Transactions of the American Society of Civil Engineers.

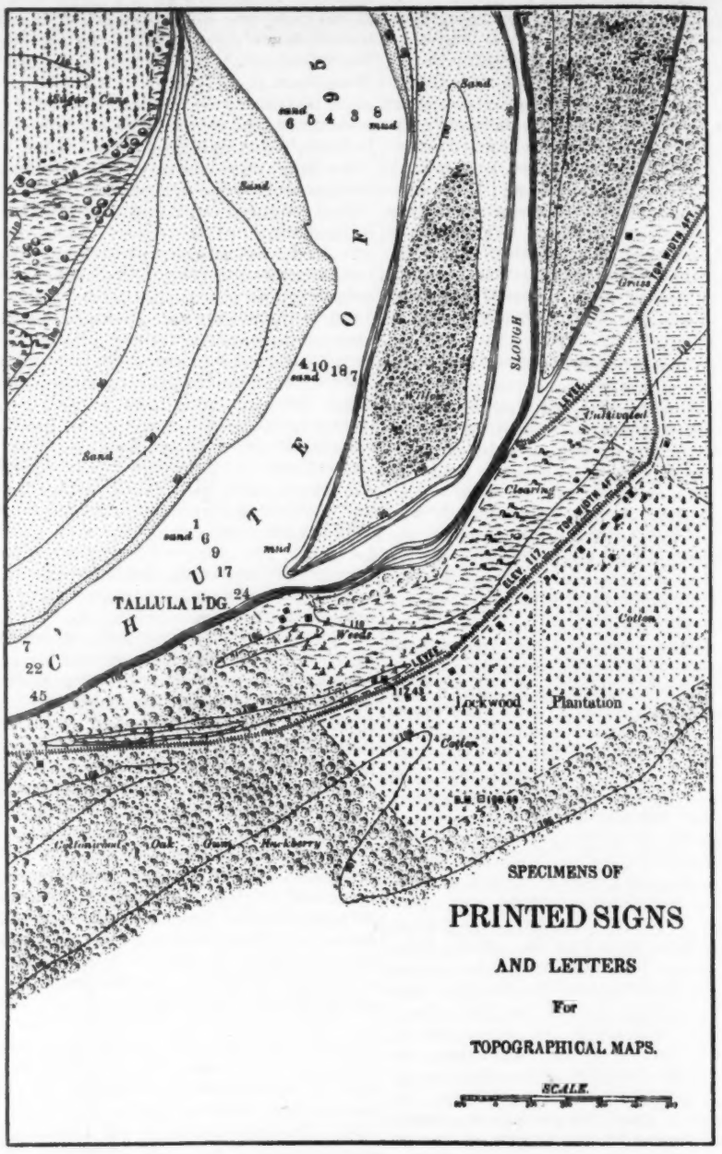


PLATE 1.

For making these characters mechanically, stamps of different kinds have been devised, but I believe that heretofore their use has not been successful, owing to the difficulty of producing characters of the required excellence, and also to difficulties of manipulation of the stamps.

In a series of maps it is desirable to have a uniform style throughout; and where the number is large, so as to necessitate the employment of several draughtsmen, this can only be accomplished by assigning a particular class of work to each man, and have each chart pass through several hands. This may be very trying to the individual, as some of the work, such as sanding, is very tedious and monotonous. On the whole, the plan serves to improve the quality of the work, but it is not calculated to increase the caliber of the employes, and should, therefore, be avoided if possible.

The recently completed topographic and hydrographic survey of the Mississippi river, from Cairo to Donaldsonville, covering some 2,800 square miles, made chiefly under the direction of the Mississippi River Commission, is projected on some 230 antiquarian (31" x 52") sheets. As it was very desirable to have the data available at the earliest time possible, I began experimenting with different devices for printing conventional signs as well as letters, bearing in mind that the results must be as good, or better, in quality than the usual hand work on similar maps, and that simplicity and speed were essential elements. The Secretary of the Mississippi River Commission, First Lieut. Smith S. Leach, Corps of Engineers, M. Am. Soc. C. E., gave me every facility for carrving on these experiments, and the results, I believe, are of sufficient importance to justify a description of the several steps which culminated in a mechanical device for printing conventional signs on original maps that has been found satisfactory in the work described above.

The first thing necessary was to find some way to construct suitable characters of metal or other hard material. Engraving was tried, but with indifferent results. Drawings one inch square were then made of two signs, cotton and woods, and the photo-electrotyping process was tried. In this way the signs were produced in type-metal and they were mounted like the rubber stamp in common use. The result was by no means satisfactory, as the individual signs did not stand out enough, and, when inked by hand, the stamp would clog up. The signs were good, and when used in a printing press, the impression was found to be a facsimile of the original drawing, with the fine lines all faithfully reproduced. Another trial was then made with

a drawing four inches square, and a special effort was made to etch as deep as possible. This was found quite satisfactory, as far as the signs were concerned, but it required too much pressure to admit of use by hand. To obviate this, rubber stamps were cast from the metal ones, and with them it was found that a single impression could be made very well, but the adjoining one, in consequence of variations in quantity of ink or pressure, would not be the same shade. Then there was also the difficulty of joining the different impressions when the area required was larger than the stamp. For areas smaller than the stamp, a stencil of the size and shape of the field to be printed was cut from thin paper, and the impression was fairly good. On the whole, a sheet of paper printed over in this way had a pattern-like appearance, due to the difference in the impressions and also to the repetitions of the forms given by the stamp.

The flat-metal stamp could not be used in printing through a stencil, and the rubber could not be relied on, so a cylinder was resorted to, the idea being that as there would only be one line in contact with the paper at a time, sufficient pressure could easily be applied. The cylinder was solid cast-iron, 4½ inches diameter by 6 inches long, and weighed about 27 pounds. An electrotype of the signs was made into a hollow cylinder of a size that would just slip over the iron one. The latter was provided with ink rollers on a suitable frame, by means of which the stamp was inked as it was rolled over the paper. The metal for this stamp was about ¼ inch thick, and, in bending it into a hollow cylinder, it was impossible to keep the surface straight. The ends would expand more than the center, hence the latter diameter would be smaller, and would, consequently, give a very light, if any, impression, while that at the ends would be heavy. The surface was too delicate to admit of hammering, so, after several attempts to remedy the defect, it was given up, and rubber was again resorted to. Rubber stamps were cast about ⅛-inch thick and these were used on wooden cylinders of the same dimensions as the iron one and used in the same frame. With this arrangement an effort was made to obtain uniformity in the impression by using a constant weight, but without success.

So far the stamps themselves were all that could be desired, and the cylinder seemed to be the proper form for them, but they could not be manipulated so as to give the required results. It was evident by this time that a uniform impression all over the map could only be obtained by using a stamp with a hard surface, and it should also be elastic so as to print through a stencil.

A copper electrotype shell, *s s*, Fig. I, Plate XXVI, was then made, and backed with rubber, *r r*, Fig. I, about ⅛-inch thick. This was wrapped around a wooden cylinder, *w w*, Fig. I, of the same diameter as the former ones, but only 3 inches long. An adjustable handle, *h h*, Fig. I, passing through the axis, giving it the appearance of a rolling-pin, completed the device. This is inked for each revolution by revolving it in contact with an ink-roller, Fig. II. In printing, it is rolled slowly over the map, the amount of pressure being regulated by the force applied at the handles. It will be seen that the full size of one revolution of the roller will be about 3 inches by 13 inches, but many of the areas, such as fields, etc., are much larger than this, and as the joining of two impressions is easy to make by laying a piece of paper along the printed edge and letting the roller overlap a little, it was not thought best to increase the length of the cylinder, as it would require more pressure.

This device was found to work perfectly through stencils of any size and shape.

There still remained one difficulty in the way of rapid execution. The outlines of the map, such as water courses, roads, etc., as well as the lettering, are necessarily put on the map before the signs. To print the signs and not interfere with these characters, which should remain clear and distinct, was quite essential. After trying several plans, such as covering with narrow slips of paper, etc., a pencil made of common starch was finally hit upon. This proved to be entirely satisfactory. To cover up a name, it is only necessary to pass the pencil over it once and the ink on the stamp will not take on the starched surface. After the printing is done the starch can be whipped off, leaving the name as clear as though it had never been touched.

The various conventional signs required by the characteristics of the country mapped, viz., woods, willows, grass, cultivated, cotton, sugar-cane, sand, etc., are now in daily use as above described. Before printing the chart, stencils are prepared for the whole sheet Any thin, transparent paper will answer for this purpose. An ordinary antiquarian sheet, covering about 900 square inches, can be prepared and printed in two days. The same work would employ a skillful draughtsman at least a month.

Sand bars, which are so tedious when made by hand, one dot at a time, can be printed to perfection with the exception of the shading at the edge, which must be done by hand. Sanding, such as is used on hydrographic charts to show different depths, can be done with an absolute certainty that the tints will be the same throughout for each depth represented.

For maps that are to be reproduced by photo-lithography, it is best to make the original large enough to admit reduction to one-half the scale. If it is desired to publish on the same scale, the printing can be done with lithographic transfer ink, and a transfer made to stone or zinc, from which any number of copies can be printed. In this case the outlining should be done on suitable transfer paper with autographic ink, and the names printed with transfer ink. Transfer this to the stone or zinc, and from this take a faint impression, called an "offset," and on the latter print the signs with lithographic ink. When this is done, transfer to the same plate that bears the outlines, and it is ready for the press, and any number of copies can be struck off.

In using the stamps described above, it is desirable to work on paper with a smooth, hard, and highly calendered surface, so that the impression will be clear and sharp. The best ink is the finest quality of "German Printing Ink."

Plate 1 is a small portion of a map on which all of the conventional signs, letters and figures were printed with the devices described in this paper. It has been reduced by photography to half the scale of the original, and as a result of the reproduction, has suffered somewhat in sharpness of detail, but it still gives a fair idea of the possibilities of mechanical mapping.

It will be readily seen that any character desired can be made and used in the manner described. Having the original drawing from which to produce the stamp, the work of the best draughtsman can be multiplied without limit, and not detract very much from the quality or style of the original. There are, of course, very fine grades of work, such as are used on small scale maps, which can only be done by hand. But for ordinary work the results are entirely satisfactory, both as to quality and cost.

Plate 2 shows the apparatus, which needs no further description. Fig. 1 is the roller, with the handles in, ready for use, and showing the electrotype shell *s s*, and the rubber backing *r r*. Fig. 11 is the ink-roller, made of common roller composition.

A stamp for putting on letters and figures is also shown, it being a valuable adjunct to the device described above.

Fig 1, Plate 2, shows one bearing a type-holder, also shown separately in Fig. 4. A set of figure discs is shown at Fig. 5. These two parts are interchangeable and can be used in the same stamp, and are only separated to show how they are attached.

Common type of suitable size and style are used. For names, etc., words are "set-up" in the typeholder and held by the clamp-screw *d*.

The base of the frame being at right angles to the line of the type in the holder, the names can always be printed parallel to the sides of the map by sliding the frame along a ruler. With a little practice this can be done with sufficient accuracy by inspection.

Where the same word is repeated frequently on the map, the time saved is very considerable, while the quality of the work is good.

For figures, such as soundings, three discs are used, each of which bears the ten digits. They revolve freely on an axis, and with them any combination from 0 to 999 can be formed. These figures are also common type, which are held in place by fitting snugly into the slots cut for them. When they become worn they can easily be replaced by new ones. With this device soundings are printed neatly and rapidly.

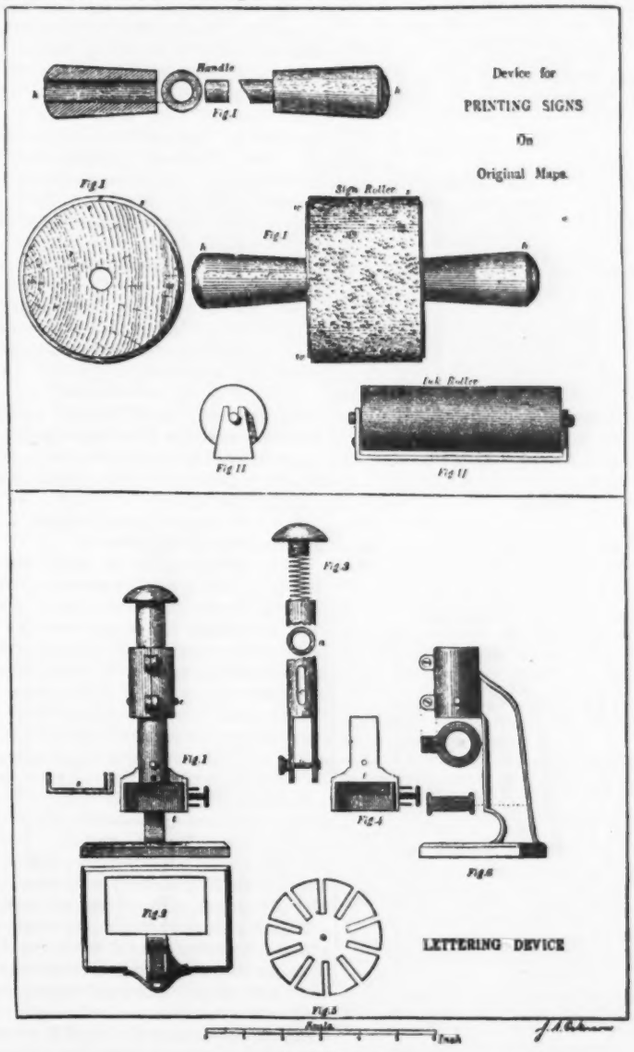


PLATE 2.

# Engineering News

AND

## AMERICAN CONTRACT JOURNAL.

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## CLUBBING ARRANGEMENTS.

### 1886.

The "subscription season" for the most popular American Magazines is close at hand, and inquiries as to our proposed clubbing arrangements are being made. We beg leave to announce, therefore, that on and after JANUARY 1, 1886, the subscription price of ENGINEERING NEWS will be **$5.00** per year; until that date the price and clubbing rates with other publications will remain as given below.

We are now planning such improvements in ENGINEERING NEWS, and negotiating for special work to be done during the coming year, as will cost double any possible increase of income from subscriptions; the long notice of change which we here give enables nearly, if not all, present subscribers to renew at present rates. We intend eventually to publish a class journal which will acknowledge no superior in the world, and we feel so confident of the support of our present patrons that we have no hesitation in venturing on the greatly increased expense necessary to carry out our programme.

If an English engineering journal, carrying fifty pages of advertisements and twenty four of reading matter sells for $10, why may not an American journal of equal merit sell for at least half as much.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals, we offer the following terms until January 1, 1886: We will send to any address ENGINEERING NEWS at regular subscription price, **$4.00** and the following at the additional prices given:

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|---|---|---|
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| Century Magazine | 3.55 | 4.00 |
| Harper's Magazine | 3.25 | 4.00 |
| Harper's Weekly | 3.25 | 4.00 |
| Harper's Bazar | 3.25 | 4.00 |
| Harper's Young People (weekly) | 1.65 | 2.00 |
| Popular Science Monthly | 4.25 | 5.00 |
| St. Nicholas Magazine | 2.55 | 3.00 |
| North American Review | 4.10 | 5.00 |
| Cassell's Magazine of Art.....m | 3.00 | 3.50 |
| Cassell's Family Magazine.....m | 1.25 | 1.50 |

The Century Magazine commences its year with the November Number; Harper's Magazine commences with the December Number. Subscribers should renew these Magazines in October and November.

## TO SUBSCRIBERS.

The date of expiration of subscriptions is given on the printed address-label attached to each copy of this paper, and is, we trust, a sufficient notice to all parties proposing to renew for the ensuing year.


THE New Jersey Steel & Iron Co., in their new "sheet of sections," show a 20-inch I-beam now made by them. The table of coefficients accompanying them indicates nearly double the strength of the 15-inch pattern with a weight of 272 pounds as compared with 200 pounds in the heaviest types of each. This is an important departure, and the new beam will in many cases take the place of riveted girders in buildings and for the stringers of railway bridges. The flanges are exceptionally wide, being 6¾ inches, adding another to its other advantages.

AT the late Invention's Exhibition in London a Mr. J. J. Hall exhibited what he calls a "train communicator." It is intended practically to perform the duty of a simple democratic bell-rope on the railway trains of America. But the English article is a wonderful compound of alarm cords, red discs, torpedoes, and machinery for working these appliances and attracting the attention of the "guard," or engine-driver. Each car requires it own outfit all enclosed in a hinged iron box. Mr. Hall combines with all this before described apparatus an arrangement for "simultaneously displaying a powerful red light" ignited by the fracture of a small glass vessel containing sulphuric acid; and further stated that a magnesium ribbon "may be introduced" to increase the intensity of this light; all of which is the result of locking passengers up in separate "compartments," with the chance of a lunatic, or worse, for a travelling companion.

SIR JULIUS VOGEL'S Report as Minister of Public Works for New Zealand, on the purchase of twelve locomotives from the Baldwin Works in this country, is not admired by our English cousins.

*The Ironmonger* after quoting a portion of it, comments as follows:—

"The whole affair is most unsatisfactory, and it is particularly vexatious to have it publicly and officially stated that not only are the Americans more prompt and accurate, but they can undersell our manufacturers to the enormous extent of £400 per engine, or about 20 per cent. If these statements are permitted to pass uncontradicted, we may be reasonably certain that our colonies as well as many other countries will naturally prefer to place their orders in the United States."

We have no sympathy with the above. It seems that through the advantages of greater skill and a sufficient capital in the business, we can build a better locomotive than the English for 20 per cent. less money and can also fill orders with greater promptness.

Under these circumstances the dictates of a sound economy should lead the English to give up manufacturing locomotives and turn their attention to the profitable production of such raw materials and other commodities as their circumstances and skill fit them for, and instead of trying to force their higher priced and inferior engines on their colonies and other countries, allow us to build (without exhibition of insular prejudice on their part) locomotives, not only for their colonies and other countries, but also for themselves. The freight on these engines will add to the earnings of their large merchant marine, and all parties will get a more servicable article for less money.

### Was it Reporter or Lecturer?

A *Tribune* reporter makes Professor Bickmore of the Museum of Natural History, in this city, give the following misinformation in regard to railroads in that much misrepresented country Mexico:

A fine view of the National Mexican Railroad at its western terminus was given. "This," said the Professor, "is the longest railroad in Mexico, and connects the capital of the country with the great seaport of Vera Cruz. It is owing to the efforts and energy of Americans that this and nearly all of the other roads in the country are built. To them alone belongs the credit of opening up the country."

### Canals as Regulators of Freight Rates.

IN the discussion on the paper read before the American Society of Civil Engineers, by State Engineer Sweet, on the enlargement of the Erie Canal, so as to allow the passage of the largest lake vessels, between Buffalo and New York, it was held by some that our cheap railroad freights were not due to the general competition of natural and artificial water routes, but that the railroads had evolved them through their own necessities. A late move of the Liverpool & Manchester Railway shows that even a *threatened* canal may influence freights; for the road having failed in its opposition to the Manchester Ship Canal, has reduced its freight on raw cotton from Liverpool to Manchester from 8 shillings to 7s. 2d., or from $1.92 to $1.72, and on boxed or baled goods, Manchester to Liverpool, from 9s. 2d., ($2.20,) to 8s. ($1.92) per ton. It seems pertinent to the question of canal enlargement generally, and the building of a larger canal in this state, to say that there are already two avenues for water communications between Liverpool and Manchester, viz.: the Duke of Bridgewater's canal and the Mersey and Irwell Navigation.

### Congressman Potter vs. the Quaker Bridge Dam.

Congressman O. B. Potter has again been overwhelming the New Croton Aqueduct Commission with figures to support his very pronounced opposition to the proposed dam at Quaker Bridge. Sixteen printed pages of tables, etc., are presented in evidence, and the deductions made from them are advanced with such self-evident conviction as to their correctness, and the estimates and conclusions of the Department of Public Works are assailed with such vigor that a few words of comment seem to be called for.

The entire argument of Mr. Potter's engineer is based upon the statement that the Department, in estimating the storage capacity required, gives no credit to the refilling of the reservoirs by rainfall between the successive drafts upon them. On this basis the engineer figures that the Department's estimate of 8,520 millions of gallons of storage drawn, in 1880, is "manifestly incorrect," and that millions of gallons of water "could not go to waste over the Croton Dam" if "the flow of the watershed had not paid back the drafts" made on the storage in previous months. He puts the actual storage required therefore at 6,065 millions of gallons, by giving "proper credit" to rainfall stored, and then builds up a formidable castle of cards.

We will not dispute Mr. Engineer's arithmetic, that is supported by the testimony of two most eminent college professors, but we fear that he has made a fatal blunder in starting out, and that all his consequent deductions are naught. The whole trouble lies in the assumption that Croton Lake is a storage reservoir, properly so called, and in the unfortunate topographical situation of the actual storage reservoirs so far as their influence in preventing waste over the Croton Dam is concerned.

Croton Lake can be safely, or effectively drawn upon for 20 inches of water only, allowing in this figure the 12-inch flash-board on the dam; the quantity of water thus represented is about 1,000 millions of gallons, from which we must deduct almost 50 per cent. for evaporation during the hot months, when the storage is actually needed. Now the total area of the Croton watershed above the Cro-

ton Dam is 338.82 square miles, and the actual storage reservoirs are situated on the confines of this area, and intercept the water from about forty square miles of this upper portion of the water-shed only. The rainfall on this forty miles will very probably add slightly to the storage in the ponds; but the fall on the remaining 300 miles, or seven-eighths of the whole area, must go somewhere, and it naturally does go to waste over the Croton Dam without the slightest chance under present conditions, of holding it back for the city's future use.

Under this true condition of affairs in the Croton water-shed, the assumption that the storage reservoirs "must necessarily be full before there can be any waste over the dam" falls to the ground, and with it all the rest of this elaborate theory resting on an airy nothing.

There are other points very worthy of consideration which seem to have escaped the keen investigation of this self-confident engineer, though the data was all spread before him in the maps and reports of the Department. The two storage reservoirs, at Boyd's Corners and the Middle Branch, collect from an area of forty square miles as stated, and these reservoirs fill each year, but, in addition to these, the Department depends for the bulk of its reserve upon a series of lakes which it controls; these lakes have exceedingly small water-sheds, sometimes barely equaling their own area, and as a consequence when once emptied, as in 1875, it takes three years to fill them again. Hence but one-third of this lake reserve can be depended upon for any one year.

Mr. Potter also blunders in crediting the Bronx supply with fifteen millions of gallons instead of only ten millions. And in his estimate of time to elapse before the city will need the increased supply proposed by the Department, he seems to forget that we are now practically ten years behind the present demand, for the supply was exhausted in 1875. As soon as the new supply is turned on and the greater pressure secured, that is aimed at by the new work, the consumption and waste of water will be at once enormously increased. The present distribution system and all household fixtures will need overhauling before the waste from the added pressure to which they will be subjected, can be checked; and in many ways the daily consumption will leap to proportions apparently undreamed of by Mr. Potter or his engineer.

Now that one and one-half years have been deducted from the time required to build the Quaker Bridge Dam, by the opposition of Mr. Potter and his friends, it is quite possible that his pet Sodom Dam will have to be constructed after all to tide over the emergency. But as it would store an amount of water from the upper end of the Croton water-shed that is entirely insufficient for the near future, and would be useless after the building of the dam that is intended to impound all of the Croton supply; its cost will simply be the price paid by the city for his unwarranted interference.

As to the further strictures of Mr. Potter's misguided engineer upon the cost of the Quaker Bridge Dam, etc., as estimated by the Department engineers, we will only apply to him and his contrary opinions a sentence quoted from his own publication, as follows:—"Any conclusions ..... based upon such misleading, exaggerated and untrue estimates of storage capacity required are made upon false premises and should be carefully guarded against."

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THE THREE SOURCES OF PROSPERITY.—"There are three things which make a nation great and prosperous—a fertile soil, busy workshops and easy conveyance of men and things from place to place."—LORD BACON.

## The Brooklyn Water Extension.

Under date of Nov. 20th, Chief Engineer Van Buren of the Brooklyn Water-works presented to the Board of Aldermen his report on the proposed extension of the water supply of that city. After briefly considering the present condition of affairs and the urgent need for an increased supply as shown in his last annual report, he incorporates the full report of Assistant Engineer I. M. de Varona which deals with the details of proposed work.

We make the following abstract of Mr. de Varona's report:—The proposed new works provide for the extension of the present aqueduct from Rockville Center to Massapequa, a distance of about 10½ miles, taking the streams of Millburn, East Meadow, New Bridge, Ridgewood and Massapequa. The surveys have been very exhaustive, embracing for purposes of comparison, three lines of conduits. The aggregate length of the transit lines was 204 miles; level lines, 176 miles, and the surveys for the purchase of land, 2113 acres.

The line adopted starts from the existing conduit near the junction of the Pine Pond Branch, converges towards the railroad and crosses it about 2½ miles from Rockville Center, and then runs generally north of, and immediately adjoining the Long Island Railroad. Its advantages are that it is the shortest, and has the best alignment; it is the most favorable in case of future extension beyond Massapequa, as such prolongation, especially through Babylon, would necessarily have to be north of the railroad; the supply of water is only slightly less than by the lower line; the expense of construction is less, because while the average depth of cutting is greater on this line, it avoids the vastly increased expense of crossing the low grounds and swamps on the lower line, and lastly, its location adjoining the railroad sensibly diminishes the expense of construction and maintenance.

Owing to the small elevation of the stream to be taken in, the water will have to be pumped before it can be taken into the existing conduit. This can not be obviated. The main distinguishing features of the new conduit plan as differing from the report of 1883, will be as follows:—The lower or first section in iron pipe instead of brick masonry; a large storage reservoir at Rockville Center; syphoning of the conduit so that all principal streams may pass over, instead of under the conduit, direct pumping from Millburn pond, and the strengthening of the proposed conduit sections.

The ground selected for the reservoir is the highest on the line, and the engine house will be adjoining the railroad, with unexcelled facilities for securing fuel. Into the pump well at this point all the waters from the streams to the east will flow through the conduit; while those from Millburn pond will be pumped direct through a 48-inch main into the reservoir, and thence delivered by a 40-inch main into the actual conduit at Rockville Center.

The maximum capacity of the conduit section would be 62,000,000 while that of the delivery pipe is only about 35,000,000 gallons. But as the latter quantity is all that is immediately required and both force main and delivery pipe can be duplicated when the demand warrants it, compound interest at 4 per cent. on what is saved by the present plan would pay for both in twelve and one-half years. The five syphons for passing under streams will be from 30 feet to 700 feet in length; they will generally be made of two lines of 48-inch mains.

The elevation of the conduit invert at Millburn is 1.33 above Brooklyn mean high tide, and the grade is one inch in 10,000, or 6½ inches per mile. As the foundation is generally compact gravel and sand, the conduit will, as a rule, be built on two courses of 4 inch planking, over this will be two inches of concrete and the brick invert generally 8 inches thick. The conduit will be built of brick excepting in a few places where there is sufficient coarse gravel, and the construction warrants concrete. The embankment over the conduit will be about 4 feet above the crown, 8 feet wide on top and with side slopes of two to one.

The storage reservoir will contain seventy-six acres; the maximum depth of water will be 22 feet and the contents 404,875,000 U. S. gallons. The inside slope will be paved to within 10 feet of the bottom with a 12 inch stone paving laid on 12 inches of broken stone or washed coarse gravel, which latter will be continued to the bottom, and for 10 feet up covered with 12 inches of concrete. The entire bottom will be covered with 2 feet of puddle, over which will be spread 4 inches of fine gravel. The elevation of high water in the reservoir will be 47 feet and that of the maximum flow-line in the existing conduit at the point of connection 12.7 feet; this gives a head of 34.3 feet in 7,600 feet of pipe, and a consequent delivery of 35,000,000 gallons. The capacity of the conduit sections, with a depth of 5.25 feet has been calculated by the formula

$$V = 1.867 \sqrt{R j}$$

For the engine house at Millburn it is proposed to adopt three horizontal compound pumping engines, having a delivery capacity of 10,000,000 U. S. gallons in twenty-four hours each, at thirty-four revolutions per minute. This allows one engine in reserve at all times.

The minimum additional supply expected from these works was about 20,000,000 gallons per day. Estimating on the water-shed of seventy-five square miles and an average rainfall of 36 inches, it is now thought that the minimum supply may be increased to 25,000,000 gallons.

Chief Van Buren, in addition to the above, again recommends the enlargement of the Ridgewood reservoir at a cost of $403,000; additional engines, boilers, houses, etc., at Ridgewood, to cost $287,000, and the raising of Hempstead pond one foot, at an outlay of $75,000. With these additions the old works can be increased to a total capacity of 75,000,000 gallons per diem, excepting the extra pumping power which can be added at any time.

Chief Engineer Van Buren submits the following summary of estimates of the cost of the new works:—

| | |
|---|---|
| For the extension of the water-works from Rockville Center to Lake Massapequa, exclusive of cost of land | $2,201,979 |
| For necessary alterations along the old conduit line, including cost of land | 75,000 |
| | $2,276,979 |
| For new engine house, coal sheds, force main, etc, at East New York, including cost of land | 287,000 |
| For the enlargement of the Ridgewood reservoir | 403,000 |
| Total | $2,966,979 |

The plan thus submitted by Mr. Van Buren is concurred in, and approved by Consulting Engineers Julius W. Adams, W. E. Worthen and A. Fteley.

## New Rules for Land-Grant Roads.

The *Daily Telegraph*, of December 1st, gives the requirements prescribed by Secretary of the Interior, Lamar, for reports, etc., from the land grant railroads. These rules, given below, are said to be devised particularly for the Union and Central Pacific roads, the directors of which are so fully impressed with the great development of the country due to the energy and speed with which their roads were opened that they seem to have sometimes overlooked the exact letter of the law governing their movements.

We are convinced that these rules would

add materially to the value of our railroad securities if they could be enforced throughout the country. Rule No. 7 will force the average director to more careful consideration of his vote; general freight agents will be prompt in demonstrating the injurious effects to follow the enforcement of rules 9 and 10, and a full statement of the expense resulting from the many reports called for will doubtless be made to Secretary Lamar. But we believe that, with the time specified in No. 5 extended in the case of those roads holding their annual meetings west of the Missouri, the rules will have the support of the stockholders.

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE COMMISSIONER OF RAILROADS,
WASHINGTON, D. C., NOV. 27, 1885.

By virtue of the authority vested in the Commissioner of Railroads, and with the approval of the Secretary of the Interior, I do hereby prescribe the following system of sworn "reports to be rendered" to me by "the railroad companies" whose roads are in whole or in part west, north or south of the Missouri river, and to which the United States have granted any loan or subsidy in bonds or lands, which system is to take effect on and after the 21st day of December, 1885.

1. Annual report to be returned to the Commissioner of Railroads, to be made on the 1st day of February of each year, and to include business to the 31st of December preceding.

2. Semi-annual report, embracing whole earnings of each road and whole earnings of each branch, net earnings of each road, and net earnings of each branch, the items of charge which make the difference of gross earnings of each road and its net earnings of each branch, and its net earnings specificially showing the items composing such difference.

A monthly report between the 15th and 15th of each month, showing the gross and net earnings of each road during the last preceding month.

4. Where a portion of any road is subsidized and a portion not subsidized a separate account and report of the actual gross and net earnings of the subsidized portion of the road and the actual gross and net earnings of the non-subsidized part.

5. A report at least ten days in advance of each meeting of the stockholders, directors and Executive Committee of the Board of Directors specifying distinctly what business is to be done or submitted for action at said meeting.

6. A report of the minutes of each meeting of the stockholders within ten days after the adjournment of said meeting.

7. A full report of the minutes of each meeting of the Board of Directors, of the Executive Committee of the Board of Directors, to be returned within ten days after adjournment of said meeting including names of directors and how each voted.

8. A quarterly report of the rates charged during the said quarter, within fifteen days after the close of the quarter, for passengers and traffic, on each road and each of its branches, both as to through and local traffic on each, and the portion of road or roads to which said rate or rates applied.

9. A distinct and full report of all special rates, to whom allowed; also all, if any, rebates, and if any drawbacks, and to whom, and the aggregate amount of each, within fifteen days after the close of each quarter.

10. All contracts made with any other railroad or transportation company or companies within ten days after such contract is made, with a copy of the contract.

J. E. JOHNSTON,
Commissioner of Railroads.

Approved—L. Q. C. LAMAR Secretary.

## PERSONAL.

It is understood at Ottawa, Ontario, that SANDFORD FLEMING, GEORGE STEPHEN, and the HON. D. A. SMITH will be knighted for services rendered in connection with the construction of the Canadian Pacific Railroad.

Hon. JESSE R. STRAUGHAN, of Fort Wayne, has been appointed Chief Engineer of the Toledo & Columbus Railroad, a road to be constructed between the points named. Mr. Straughan is the father of Joseph C. Straughan, newly-appointed surveyor general of Idaho.

CHARLES ACKENHEIL, late of Pittsburg, Pa., has been appointed Consulting Engineer to the Staten Island Rapid Transit R. R. Co. He is now making surveys for this road from Elizabethport to Bound Brook, and the preliminary investigations for a bridge crossing the Arthur Kill. Mr. Ackenheil has his office and residence in Elizabeth, New Jersey.

CHARLES H. FISHER, for many years Chief Engineer of the New York Central & Hudson River R. R., is suffering from softening of the brain. This sad outcome of Mr. Fisher's efficient services is to be especially regretted as he was one of the most successful railroad engineers in the country, and under his direction many of the most radical improvements on the road lately in his charge have been made. He is now retired on half-pay and resides at his home in Lansingburg, N. Y.

A private cable dispatch, of November 24th, announced the death at Southampton, England, of R. Johnston Neven, at one time on the New York bench, but better known in political and railroad circles. He was seventy-three years old. He was the tried friend of Presidents Pierce and Buchanan. A large estate is left to his wife, a son, and two daughters. He married the widow of Congressman Horace F. Clark, the president of the Lake Shore Railroad. His only sister is the mother of Mrs. Chauncey M. Depew.

Mr. EDWARD MCGILLIVRAY, one of the most widely known commercial men in the Ottawa Valley, died at his home in Ottawa on the 24th, ult., of paralysis of the brain. For nearly fifty years he carried on a large wholesale and retail trade, and had extensive business connections with the lumbermen of the Ottawa Valley. He was Mayor of Ottawa during the years of 1858 and 1859 and was connected with every enterprise for the advancement of the place from the early days of Bytown down to the present. The Montreal Telegraph Co., the St. Lawrence & Ottawa Railway and the Canada Atlantic Railway are among the most prominent enterprises to which Mr. McGillivray lent the aid of his energetic assistance.

The death of PETER DONOHUE removes one of the most conspicuous of the self-made men of San Francisco. He went there in early days and was a skilful engineer and iron founder. He built the first gas works in that city. He managed the first great foundry, he built the city railroad and other rail works. He launched steamers and was the principal contractor for the Monitor *Comanche*, for which there was such longing in war times, when it was believed that trouble with England and afterward with France was seriously threatened. He made a large fortune which he used in developing the State. He caught the cold which led to his death at Sharon's funeral and he aggravated it by the inspection trip over his railroad, the Northern Pacific.

The following biographical anecdote of JAY GOULD, the American millionaire, whose approaching visit to Paris we have already announced, will be read with interest:

"JAY GOULD started in life in New York twenty years ago without a cent in his pocket. He was about to be expelled from the little room he had rented as he was unable to pay for it and as a last resource he went and related his misfortunes to one of his neighbors, a shirt-maker, who took pity on him and lent him $100. Gould paid his debts and started for San Francisco. A few years afterwards a stranger presented himself at the residence of the shirt-maker and happened in just as the latter, surrounded by his neighbors, was celebrating his daughter's wedding. The stranger made himself known: his name was Jay Gould. A most touching scene of gratitude took place between Gould and his former savior; but Gould had not come solely for the purpose of enacting a little domestic drama; he had at heart only the payment of a debt and he handed the astonished shirt-maker a check for $100,000."—Paris *Gaulois*.

### American Society of Civil Engineers.

A regular meeting of the Society was held at its house on Wednesday evening, Dec. 2, President Graff in the chair and a very full attendance of members present. The Secretary announced that the next Annual Meeting would be held in this city, commencing at 10 A. M., January 20; a notice was also read from the trustees of the Elizabeth Thompson Bequest that a considerable sum of money was ready for distribution, early in January 1886, under the terms of that bequest which stipulated that the income of this fund was to be expended in aiding scientific research in any direction that had for its purpose the general benefit of society. The President named the committee suggested at the last Annual Meeting to investigate and report upon the compression of cement and the settlement of masonry as far as the latter related to the closing of the joints; the members are as follows:—Messrs. F. Collingwood, D. G. Whittemore, W. W. Maclay, A. S. Abbott, Col. T. L. Casey, and Prof. G. F. Swain.

The first paper of the evening was upon the subject of "Wind Strain in Bridges," read by the author Mr. W. Howard White. A written discussion followed upon Mr. G. H. Pegram's paper "On Formulas for the Weight of Iron and Steel Railway Bridges, presented at the June Convention; the members taking part were Prof. Dubois, Prof. Burr, Mr. G. S. Elliott and the author. Mr. Corthell's late paper on Canals and Railways, Ship Canals and Ship Railways then brought out a lively and decidedly personal critism by Mr. A. G. Menocal, and answers to the same from Mr. E. L. Corthell and Col. Walter MacFarland, the whole controversy turning upon the Nicaragua Canal vs. the Tehuantepec Ship Railway.

The following gentlemen were announced as elected to membership in the Society:

*Harry Hubbard Latham*, formerly Chief Engineer Battle Mountain and Lewis Railroad in Nevada; now Chief Engineer Utah and Wyoming Railway, Chicago, Ills.

*Frank McDowell Leavitt*, formerly Superintendent of the Graydon & Denton Manufacturing Co., of Jersey City; now Superintendent for E. W. Bliss, Manufacturer of Presses, Dies and Special Machinery, Brooklyn, N. Y.

*Arthur Macy*, (elected Junior July 12th, 1877) Superintendent Silver King Mining Company, of Arizona; Silver King, Arizona.

*Arthur Pou*, formerly Division and Resident Engineer on Construction, Mexican Central Railway; Principal Assistant Engineer Aguascalientes and San Luis Potosi Division, Mexican Central Railway; Chief Engineer Dublin (Ga.) and Wrightsville R. R.; now Chief Engineer Macon and Dublin R. R., Talbotton, Ga.

### Engineers' Club of Philadelphia.

(Record of Regular Meeting, November 21st, 1885.)

Past President Rudolph Hering in the chair; 60 members and 4 visitors present. The Secretary presented, for Mr. W. S. Church, a large number of photographs, tracing, pamphlets and other documents, illustrating the design and progress of the New Croton Aqueduct, and read two communications from Mr. Church. He says: The "*ground*" through which the tunnel is advancing, is largely gneiss with considerable limestone, feldspar, and occasional quartz seams. The dips are so vertical that much roof rock comes away. This trouble is increased by the too free use of high explosives near the perimeter of the vertical section, so that the area excavated runs from 25 to 50 per cent. in excess.

"A most careful system of measuring and recording just what is excavated is being carried out. A vertical dial, which the boys call 'The Sun Flower,' is set up every 10 feet, and oftener if necessary, and radial mea-

surements taken to all the inequalities of the section; these measures are plotted on the diagrams, and the areas estimated with the planimeter.

The principal difficulty that the line has yet encountered, is the Gould Swamp. It has finally been decided to under-run this in solid rock with a syphon, making a blow-off below grade and draining by an adit out into the Hudson River."

In Vol. V, No. 1, page 13, in a discussion of Mr. A. Harvey Tyson's paper on Pollution in Storage Reservoirs, I notice that Mr. Charles G. Darrach says, 'I would call attention to the fact that in the proposed Quaker Bridge Dam for the New Croton Aqueduct no provision seems to have been made, as far as can be learned from published plans, for draining off the water from the lower levels. As this dam will be of almost unprecedented depth, the same trouble may be expected as in Baltimore and Reading, unless this precaution is taken.' "The Club will observe from the drawing sent, that this criticism is fully met, and that the big reservoir of the Croton will, when constructed according to present designs, have the best *circulation* of any reservoir in the world."

Mr. Jno. S. Elliott presented a paper on Specifications as Affecting the Dimensions of Iron R. R. Bridges.

A discussion followed upon the paper of Mr. James Christie upon the Adaptation of Steel to Structural Work. Mr. Thos. M. Cleemann thought the use of steel instead of iron by engineers was dependent principally on the manufacturers produciug a perfectly uniform and reliable product, which at present they do not seem to do. He thought that the advantage of using a cast metal was in favor of steel, by which struts could be made of a hollow circular section, requiring least material, and the punching of holes for fastening pieces together by riveting, which especially weakens steel of a high grade, could be dispensed with.

Mr. James Christie said in reply, that it was very improbable that struts would ever again be made directly from castings. Aside from the difficulty of maintaining a uniform thickness of metal, the cost of construction would be greater than by the present method of building up rolled material.

Prof. Wm. H. Burr said the steel question presents itself to engineers under two entirely different aspects. The first involves the character of the metal *per se*; and the second is based upon the consideration of the influence of this metal on structural design. In the first place, although improvements in the uniformity of production can yet be made, steel makers, by either the Bessemer or open hearth processes, are ready to work under any physical specifications affecting uniformity that may be demanded by the best engineering practice of the present time; and it may be safely asserted that increased uniformity will keep pace with any demand.

Unfortunately, however, there seems to be considerable diversity in the results of experiences with the many and varied shop manipulations necessary to the completion of the structural member. Mr. Christie tells us that in supplementing his most admirable tests on angle iron struts, by those on composite riveted columns, he found the ultimate unit of stress in the latter essentially equivalent to that realized in the former. On the other hand, I am credibly informed by the chief inspector of an extensive railway system, that some full sized high Bessemer steel latticed columns built for a large bridge failed, when tested to destruction, to give much, if any, excess over corresponding wrought-iron columns. These and other similar results suggest the possibility, or even probability, that the known sensitiveness of high steel demands a more extensive experimental experience with finished bridge members before the general use of such metal in columns can be considered satisfactory. Low structural steel of 60,000 to 65,000 pounds ultimate tensile resistance, is capable of any duty in the finished structure in the most satisfactory manner, and high steel of 80,000 to 90,000 pounds ultimate tensile resistance will eventually be equally reliable, but there are serious reasons for much care in its present use. The effect of the introduction of steel on structural design has not yet received the same consideration as that of constructive processes. With the increased working stresses allowed in steel, the coefficient of elasticity remains essentially the same as for wrought-iron, with its lower allowable stresses. With the same design in both metals, the result is an increase of strains for steel in direct proportion to the unit stresses, and precisely the same proportional increase of deflections. The present and increasing requirements for rapidly moving loads make this a very serious aspect of the question, and give rise to a corresponding modification of design, so that proper stiffness as well as strength may be maintained. A comparison of the deflections of the Niagara and St. John's cantilevers, shows very clearly the effect of a constant coefficient of elasticity with an increased working stress. The principal dimensions of these structures are sufficiently near in value to afford a very interesting comparison. The greatest deflection of the Niagara Bridge, with its high steel compression members, with working stresses that cannot be far from 9,000 to 10,000 pounds, in combination with wrought iron tension members, was $7\frac{5}{16}$ inches; while that of the St. John's Bridge, with all members of about 60,000 pound steel and corresponding working stresses, was 4 inches. A proper allowance for the compression of the steel piers of the former leaves a remaining difference of over 2 inches. Again, the effect of alternate stresses of opposite kinds on the design of steel members, is still a matter in almost a purely conventional state. The experiments of Weyrauch and Spangenberg are of the right kind, and constitute a long step in the right direction; but it must be borne in mind that these experimenters treated specimens and not structural members. The ultimate physical condition of steel furnishes strong reasons for believing that its fatigue under compression will be considerably less than that of wrought iron.

Mr. Geo. S. Strong presented an illustrated description of Rack Rail Appliances for railroads with very heavy grades. Mr. J. Foster Crowell presented an illustrated paper upon Masonry Arches, treating mathematically the determination of dimensions of voussoirs in difficult cases, and giving the result of his experience as to methods of withdrawing centers. Mr. A. R. Roberts exhibited an appliance for Fastening the Floor Timbers of Highway Bridges to the iron I beams of the floor system. It consists of a piece of flat wrought-iron cut from the ends towards the middle, the divided portions being bent at right angles to the piece so that one opposite pair, after being ragged, can be driven in the wood, and the other pair bent under the flange of the iron beam.

Mr. Henry G. Morris introduced Mr. P. Oestburg, who exhibited specimens of and described the Mitis Metal Castings, which are made from wrought iron and have a very high ductility.

Mr. Wm. H. Dechant presented a description of a Movable Dam and Caisson Operating Truck, illustrated by a small model and photo-lithograph plates. He claims a number of advantages in the system over the French or Chanoine system of Movable Dam, constructed by the United States Government at Davis' Island, below Pittsburg, namely: a wicket of more simple construction, having a less number of wearing parts, and more positive action; less liability of being damaged by ice snags, or any other body passing over them when down; a simple appliance to throw the wickets down either separately or collectively; a caisson-operating truck to enable one wicket, or a certain number of them, to be quickly and effectually enclosed from the water above the dam to allow repairs to be made, and also to enable the attendants to get immediately over the wickets and dam, so as to make careful examinations and be in a positive position to raise the wickets; making it practicable wherever necessary to use steam power to operate the dam, instead of depending upon manual labor. The system also applies to flush strips on top of permanent dams; and they are in practical use on several of the dams on the Schuylkill Navigation; where the flash strips from 10 to 18 inches in height are used, they are operated directly by a man walking out along the comb of the dam, one man being able to raise or lower such a wicket 10 feet long with ease.

The Secretary announced the death of our fellow-member, Mr. Dwight Edward Pierce, and Mr. M. W. Rudderow presented a narrative of his experience and achievements, as a Memorial for publication in the Proceedings.

HOWARD MURPHY, *Secretary.*

### Boston Society of Civil Engineers.

A regular meeting of the society was held on Wednesday the 18th inst. Vice President L. F. Rice in the chair, forty members present. U. S. G. White, F. L. Libbey, W. T. Pierce and Dwight Porter were elected to membership in the society.

A paper on the Water Works of Charlottesville, Va., was read by E. D. Bolton and a paper on the construction of a sewerage tunnel in Worcester, Mass., by Wm. Wittaker.

THE removal of the impediments to the navigation of the Danube at the "Iron Gate" is to be carried out at last, in conformity with the stipulations of the treaty of Berlin. The Hungarian government has decided to have the work executed. The cost is estimated at $6,000,000.

## CORRESPONDENCE.

### Test for Cement.

NEW YORK, Dec. 1, 1885.

EDS. ENGINEERING NEWS: In these days of large engineering enterprises much is published relative to qualities of the different kinds and different brands of hydraulic cements; their degrees of excellence, results obtained, and the proper methods of verifying them.

I would venture the assertion that there is but one proper way to test any cement, and that is "chemical analysis." By this is meant a complete quantitative and qualitative analysis by not less that two, or better three cements standing high in the profession. In this analysis, those having it in charge should be thoroughly conversant with the practical results sought for, viz.: durability combined with availability. Any investigation of this kind must have its origin with the desire on the part of engineers having vast work in charge to acquire information enabling them to give to the country enduring monuments of their skill. They have at stake more than any other class.

The manufacturers are not likely to take up the question for it may demonstrate faulty methods, imperfect combinations and lack of advancement in the art of manufacture, the reliance on habitual use or accepted reputation.

They may be expected to oppose any proposition of this kind, for certain it is, that a thorough examination in this direction will overturn many accepted theories, change entirely many erroneously acquired methods, and very likely destroy the prestige of some brands of accepted cement.

MANUFACTURER.

In this issue will be found a series of chemical tests of cements as made by Chemist De Smedt of the District of Columbia. Any investigation tending towards the securing of uniform excellence and the highest degree of strength in the manufacture of cements must be desirable: but we believe that there are manufacturers in this country quite as anxious and willing to

furnish a standard article as engineers are to use it. Business instinct alone would suggest that the best cement will find a ready market wherever the user is capable of judging of the merits of various brands.

ED. ENGINEERING NEWS.

## "Drilling Power" on the South Pennsylvania R. R.

FANNETTSBURG, Pa., Nov. 30, 1885.

Editor ENGINEERING NEWS: I see that in your issue of November 21st, Mr. F. M. Pierce, President of Ingersoll Rock Drill Company, demurs to the following statements made in the "Reports on Methods of Working Tunnels on the South Pennsylvania Railroad" viz.: that at East Blue Mountain—West Kittatinny and both ends of Tuscarora tunnels—the "greatest difficulty" was "lack of drilling power,"—and assumes that these statements imply a criticism of the compressors.

In explanation of these reports I would say that the term "greatest difficulty" was used as meaning the greatest hindrance to better progress and the term drilling power as referring to all the means used in drilling the rock ready for blasting, and that the latter did not necessarily refer to the compressors alone.

An insufficient number of drills, incompetent handling of compressors or drills, and other causes, as well as insufficient capacity of compressors, might have accounted for the "lack of drilling power."

At the places named, better progress could have been secured, had the means for drilling been more efficient. There was room for more drills, and the mucking force was below the practicable maximum number, and in the case of West Kittatinny, this force was very often "knocked off" entirely for half and whole shifts waiting for the drilling, which was behindhand.

The comparison made by Mr. Pierce between the east and west ends of Blue Mountain Tunnel does not in my opinion prove the "misuse of machinery," at East End (although the fact is that this machinery was misused) and competent handling at West End, for the reason that at East End the rock was hard sandstone, and at West End soft shale.

Had the efficiency for drilling been the same at each end, the greatest hindrance to progress at East End might have been with drilling, and at the West End, with the removal of "muck."

Yours respectfully, W. H. ATWOOD,
formerly Division Engineer, Div. No. 2, S. P. R. R.

[We have seen Mr. Pierce, and he says that his letter was called out by a very natural misinterpretation of the term used in the published report. The letter of Mr. Atwood explains the true meaning intended.—ED. ENG. NEWS.]

## Annual Report of Chemist E. J. De Smedt to the Engineer Department of Washington, D. C.

This report, just submitted, includes the chemical and mechanical analyses and scientific investigations made for the Engineer's Department, Health Department and the new waterworks of Washington, D. C., for the fiscal year, ending June 30, 1885.

Mr. De Smedt reports as follows on the water supply:—During the months of May and June, 1885, considerable excitement was created in regard to the purity of the water supply of this city. Twenty-three analyses were made at the time by several prominent chemists of the different departments of the goverment, and some were made by myself.

A portion of the samples were taken direct from the Potomac river, some from the different lakes and reservoirs, and others from the water-pipes in the city.

The conclusion we arrived at was, that the water supply of the city, like all river water, is of a variable quality, owing to climatic influences, but that it is nevertheless, good, potable water and of a healthy character. This subject has been treated in my former annual reports.

The following statement will show the result of my last analysis of a sample of the water supply:

| | |
|---|---|
| Appearance | turbid. |
| Hardness | 4 degrees. |
| Solid Residue | 94 millgs. per lit. parts per mill. |
| Organic and Vo'atile | 30 " " " " |
| Mineral Matter | 64 " " " " |
| Free Ammonia | 0.06 " " " " |
| Albuminoid Ammonia | 0.08 " " " " |
| Nitrites | slight traces " " |
| Nitrates | 0.4 " " " |
| Chlorine | 4. " " " |
| Oxygen Required | 0.42 " " " |
| Microscopic Examination | good " " " " |
| Opinion | Good potable water. |

In regard to the fish-like odor which has been detected in our water supply, all scientific authorities agree in attributing it to the formation of microscopic algæ, such as confervaceæ, oscillatoriæ and protococci, but there is no evidence to warrant a suspicion that this water will produce any deleterious effect upon the health of those who drink it. The formation of these algæ and likewise the fish-like odor, has, this summer, been quite general all over the United States; it is also remarked, periodically, more or less, in other parts of the world.

I was unable to experiment on the algæ found in our reservoirs, owing to the fact that they had all disappeared when I endeavored to procure specimens.

The methods I have adopted in the examination and analysis of water, have been fully described by me in the report of the Health Officer, D. C., for the year 1880, still, I deem it proper to say a few words in regard to the examination of water by the aid of the microscope, without which the analysis would be incomplete, notwithstanding its use is often neglected by the analyst.

In as much as it is in the character, rather than the quality of the organic matter found, by which we judge the quality of water in a sanitary point of view, we are necessarily obliged to go into the most minute details connected with the subject-matter, and here it is that the microscope becomes indispensable, and very often gives us that precise information which enables us to determine the nature of the organic matter referred to.

The corpuscules visible under the microscope are sand, clay, chalk, etc. The vegetable debris consists of leaves, fibres, etc. Animal debris arises principally from insects. The living organisms found in water consists of Vibrions, Bacteriæ, Algæ, Diatomaceæ, Infusoriæ, eggs of Taniæ, of Ascaridas and a multitude of microscopic organisms which are generally found in polluted water.

The re-agents I generally employ, are a solution of iodine, which gives a blue color to the anylaceous cells. Second: A solution of carmine in glycerine and alcohol which colors red the vegetable cells. Third: The violet methylene which colors the bacterias.

Now, inasmuch as it is sometimes difficult to ascertain the putrescibility of water by the direct microscopic examination only, I also make use of the method adopted by Dr. Angus Smith, (Revue d'hygiene et de police sanitaire; tom. V, No. 9) which is as follows:

Dissolve 5 grammes of pure gelatine with 2 centigrammes of phosphate of soda in 100 grammes of pure distilled water, then add fresh albumen and heat the whole to 100° Centigrade for the purpose of clarification, then filter; 25 c. c. of this solution is mixed with 25 c. c. of the water to be examined, the tubes when filled are kept for a few minutes in a water bath at 25° Centigrade in order that assimilation will be perfected; the tube is then closed with clean cotton and kept for several days in a warm place heated to about 30° to 35° Centigrade. When the water, which is added to the gelatine solution, is perfectly pure (boiled distilled water) the liquid under examination remains almost intact, but when, on the contrary, the water is impure, the living organisms are as so many centres of action which decompose the gelatine and give it the appearance of oily globules, proportioned in quantity to the ratio of impurity of the water under examination.

On the second day, some white points are visible; on the third day the little globules appear in much greater number. A turbid division is now remarked at the surface and the microscope shows the presence of a multitude of Bacterias. On the fourth and fifth days, this turbid division becomes greater and the gelatine becomes liquid, beginning at the upper division and this change is effected more rapidly in proportion to the impurity of the water. When the water is infectious the upper part is liquified and becomes milky and putrid at the expiration of forty-eight hours.

The above process is very valuable for the purpose of determining the relative purity or impurity of water. I have also adopted, in doubtful cases, the method pursued by Dr. Koch, which is based on the same principle as that described above, but with this difference, that the examination is made with a certain number of drops, or a fraction of a drop of water, and the number of colonies of microbes are counted in a given space; knowing the volume of water mixed with the gelatine, we can readily calculate the number of microgerms susceptible of development, in a centimeter cube of water and thus arrive at the result.

In the report to the Engineer Department, the average percentage of asphalt cement in 165 samples of asphalt pavement laid in the District, were:

| | | | |
|---|---|---|---|
| Chemically pure asphalt cement. | 9.20 | Commercial | 13.80 |
| Carbonate of Lime | 5.00 | | |
| Granite Stone Dust | 7.00 | | |
| Sand | 78.80 | | |
| | 100.00 | | |

The average composition of asphalt block was:

| | | | |
|---|---|---|---|
| Asphalt cement, chemically pure | 7.50 | Commercial | 11.25 |
| Broken stone CaO. $Co^2$ | 92.50 | | |
| | 100.00 | | |

The cement report, though voluminous, contains information sufficient to warrant its publication in full. We give it as follows:

All the hydraulic cements used on the public works of the District, have been submitted, at my laboratory, to a daily test as to their tensile strength, and weekly reports of the results obtained, together with the localities where used, were submitted to Capt. Greene and Lieut. Townshend, U. S. Engineers. The following tables show the average tensile strength per square inch of the various kinds of light burned (home made) and Portland cements in use here.

HYDRAULIC PORTLAND CEMENT.

| Name. | Fineness on Sieve No. 50. | Quantity of Sand and Cement. | 1 day | 5 days | 10 days | 15 days | 20 days | 30 days | 60 days | 6 months | 12 months | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alsen & Son | 1 | neat | 170 | 275 | 289 | 340 | 360 | 404 | 467 | 561 | 690 | Imported |
| Whi do te | | 2 sand 1 cement. | ... ... | 97 | 150 | ..... | ..... | 266 | ..... | 290 | 360 | do |
| | 14 | neat | 95 | 200 | ..... | 268 | ..... | 364 | 400 | ..... | ..... | do |
| do | | 2 sand 1 cement. | ..... | ..... | ..... | ..... | ..... | 175 | 220 | ..... | ..... | do |
| Dyckerhoffs | 5 | neat | 120 | 250 | 3?5 | ..... | 350 | 466 | 509 | 650 | 695 | do |
| do | | 2 sand 1 cement. | ..... | ..... | 165 | ..... | 205 | 247 | ..... | ..... ..... | 380 | |
| Giant | 0 | neat | 150 | 304 | 3?5 | ..... | 400 | 416 | 505 | 673 | 700 | American |
| do | | 2 sand 1 cement. | ... ... | ..... | 150 | ..... | ..... | 270 | ... | ..... | 425 | do |
| Egypt | 2 | neat | 100 | 2?5 | 270 | ..... | ..... | 355 | ..... | ..... | ..... | |
| do | | 2 sand 1 cement. | ..... | ..... | ..... | ..... | ..... | 180 | ..... | ..... | ..... | |
| Brooks and Shoobridge. | 7 | neat | 90 | 300 | 340 | ..... | ..... | 420 | ..... | 537 | 725 | Imported |
| | | 2 sand 1 cement. | ..... | ..... | 150 | ..... | 188 | 234 | ..... | ..... ..... | 385 | |
| Shepherdstown | 0 | neat | 35 | 70 | 100 | 119 | 124 | 180 | 260 | 353 | 360 | |
| do | | 2 sand 1 cement. | ..... | 25 | 36 | 41 | 70 | 95 | 118 | 140 | 189 | |
| Round top | 5 | neat | 40 | 90 | ..... | 109 | 150 | 205 | 255 | 360 | | |
| do | | 2 sand 1 cement. | ..... | 20 | 30 | 40 | 72 | 100 | 120 | | 380 | |
| Union | 3 | neat | 70 | 120 | 150 | 250 | 295 | 315 | ..... | 150 | 180 | |
| do | | 2 sand 1 cement. | ..... | 80 | 95 | 101 | 130 | 160 | ..... | ..... | ..... | |
| Lawrence | 5 | neat | 35 | 75 | 95 | 115 | 125 | 170 | 240 | ..... | ..... | |
| do | | 2 sand 1 cement. | ..... | 22 | 30 | 35 | 62 | 90 | 108 | ..... | ..... ... | |

### LIGHT-BURNED HOME MADE HYDRAULIC CEMENTS.

The cements of this class in the District are the Shepherdstown Potomac Cement, the Round top Potomac Cement, the Lawrence Rosendale Cement and the Union Pennsylvania Cement. This last named cement is partly made on the system of the Portlan l Cement and is more of the character of a high burned cement. As an ordinary cement it has given excellent results as to strength, &c., during the present fiscal year, but inasmuch as it does not possess the strength of a good Portland Cement and has been placed on the market as an ordinary cement; I have placed it on the table of the light-burned home-made cements.

In my preceding reports I have repeatedly stated that it is by chemical analysis we ascertain the character and quality of a cement, but in order to make that statement more explicit, I will make the following explanations:

Portland cement is composed of bi-basic silicate of lime and aluminate of lime, sometimes it contains small quantities of magnesia as silicate or aluminate, some oxide of iron, alkali in small quantity, etc. Silicates and aluminates of lime are the principal constituents of Portland Cement, the formulas of which to calculate with, are as follows:

| | |
|---|---|
| $^2$CaO. $SiO^2$— Lime | 65.12 |
| Silicic Acid | 34.88 |
| | 100.00 |
| $^2$MGO. $SiO^2$— Magnesia | 57.15 |
| Silicic Acid | 42.85 |
| | 100.00 |
| CaO. $Al_2O^3$— Lime | 67.33 |
| Alumina | 32.67 |
| | 100.00 |

The magnesia may be calculated as lime when found in small quantities.

A limestone, such as dolomite, containing 46 per cent. of magnesia, has been pronounced unfit for making good cement, but when the percentage of magnesia is not too large, it becomes in time, just as hard as a cement containing no magnesia, with this difference that it is somewhat slow in setting. In sea water containing magnesia, such cement should be preferred for the reason that it does not disintegrate in that water.

After careful analyses, calculations and comparative

tests, I have found that the best results are obtained when the relative quantity of alumina is in the proportion of between one-third and one-fourth to the total amount of alumina and silica found by analysis. The quality of Portland Cement is perfect in proportion as the above formula are closely adhered to in its composition. Sulphuric acid in more than one per cent. is detrimental, and a small percentage of alkali, such as soda or potash, adds very much to the virtue of the cement.

Now, it is not sufficient that the proportions should be correct, it is also necessary that calcination should be at the proper degree of heat and length of time, in order to produce the formation of bi-basic silicate of lime and aluminate of lime.

Having shown the proportions of the constituents of Portland Cement, we will now prove by analyses made of the best known Portland Cements and by actual tests of the strength of the same, that when the composition is made according to the above formula, the best results are obtained.

The differences between these two cements are as follows:

1st. The Shepherdstown cement contains a greater percentage of Magnesia than the Round top cement.

2d The Shepherdstown cement contains of Bi-basic Silicates..... 68.61%
While the Round-top contains..... 71.77%

Difference in favor of the R. T..... 3.16

3d The Shepherdstown cement is a very fine powdered cement—almost impalpable, while the Round-top is not so fine, giving 5% residue on a sieve numbered 50.

4th. The Round-top cement is a quicker setting cement than the Shepherdstown.

5th. The Round-top cements break higher than the Shepherdstown—both cements being composed of neat cement.

6th. The Sheperdstown cement when mixed with 2 parts of sand, and 1 part of cement has equally as great tensile strength as the Round-top and even more after an elapse of 12 months.

I will now endeavor to explain the differences.

1st. The Shepherdstown cement takes longer to set than the Round-top owing to its containing a greater quantity of magnesia.

2d. Neat Round-top cement possesses greater tensile strength than neat Shepherdstown, on account of its containing a larger percentage of bi-basic silicates; but when mixed with sand, these two cements are almost equal in strength, with a slight leaning in favor of the Shepherdstown, this is accounted for by the extreme fineness of the Shepherdstown and the relative coarseness of the Round-top cement.

To sum up this subject, it will be readily seen that the analyst is in a position to determine accurately the merits and demerits of cements, from knowledge based upon scientific principles, which long experience has demonstrated to be correct, and which when reduced to practice, will undoubtedly produce the best qualities of hydraulic cements.

In concluding this my annual report, I trust that my labors have resulted in shedding some light upon the subject of cements that will prove valuable, not only to the manufacturer, but also to the consumer and more particularly in regard to the manufacture of Portland cement in this country, where the raw material abounds in such unlimited quantities that there is no reason why we should not become the exporters of this valuable commodity instead of importers, as we still are to a great extent.

## ANALYSES.

### GERMAN PORTLAND CEMENT (DYCKERHOFF.)

| | | | | | |
|---|---|---|---|---|---|
| Silica | 2.11 | calculated as bi-basic silicate of lime | 60.50 | Lime | 39.39 |
| Alumina | 11.30 | " as aluminate of lime | 34.59 | " | 23.29 |
| Oxide of iron | 3.36 | Aluminate and bi-basic silicate of lime | 95.09 | " | 62.68 |
| Lime | 58.28 | Lime, magnesia and alkali found by analysis | | | 61.92 |
| Magnesia | 2.93 | | | | |
| Alkalies | 0.71 | Difference between analysis and calculation | | | .76 |
| Sulphuric acid | 0.25 | | | | |
| Carbonic acid | 0.93 | | | | |
| Insoluble residue | 0.49 | | | | |
| Water | 0.51 | | | | |
| Loss | 0.20 | | | | |
| | 100.00 | | | | |

### ENGLISH PORTLAND CEMENT.
(Brooks & Shoobridge.)

| | | | | | |
|---|---|---|---|---|---|
| Silica | 22 74 | calculated as bi-basic silicate of lime | 64.90 | Lime | 42 16 |
| Alumina | 7.74 | " as aluminate of lime | 23.38 | " | 15.54 |
| Oxide of iron | 3.70 | Aluminate and bi-basic silicate of lime | 88.28 | " | 58.70 |
| Lime | 57.68 | Lime, magnesia and alkali found by analysis | | | 58.88 |
| Magnesia | 0.57 | Difference between analysis and calculation | | | 0.18 |
| Alkalies | 0.63 | | | | |
| $SO^3$ | 0.66 | | | | |
| Carbonic Acid | 3.50 | | | | |
| Residue | 0.53 | | | | |
| Water | 1.90 | | | | |
| Loss | 0.41 | | | | |
| | 100.00 | | | | |

### ALSEN & SON, (Portland Cement.

| | | | | | |
|---|---|---|---|---|---|
| Loss by calcination | 1.16 | | | | |
| Silica | 24.90 | calculated as bi-basic silicate of lime | 71.30 | Lime | 46.40 |
| Alumina | 6.81 | " as aluminate of lime | 20.84 | " | 14.03 |
| Lime | 59 98 | Aluminate and bi-basic silicate of lime | 92.14 | " | 60.43 |
| Oxide of iron | 5.41 | Lime, magnesia and alkalies found by analysis | | | 60.76 |
| Sulphuric acid | 0.86 | Difference between analysis and calculation | | | 0.33 |
| Magnesia | 0.38 | | | | |
| Alkalies | 0.50 | | | | |
| | 100.00 | | | | |

### GIANT PORTLAND CEMENT (American.)

| | | | | | |
|---|---|---|---|---|---|
| Loss by calcination | 2.46 | | | | |
| Silica | 24.36 | Calculated as bi-basic silicate of lime | 66.97 | Lime | 43.61 |
| Alumina | 8.07 | " aluminate of lime | 21.70 | " | 16.63 |
| Oxide of iron | 4.83 | Aluminate and bi basic silicate of lime | 91.67 | Lime | 60.24 |
| Lime | 59.28 | Lime, magnesia and alkali found by analysis | | | 60.78 |
| Magnesia | 1.00 | Difference between analysis and calculation | | | 0.54 |
| Alkalies | 0.50 | | | | |
| Sulphuric acid | 0.50 | | | | |
| | 100.00 | | | | |

We will now endeavor to show the difference between the High burned Portland cement and the Light burned cement, such as the Potomac hydraulic and the Rosendale hydraulic cements and we will demonstrate that in the Portland Cement, the lime is combined with silica as bi-basic silicate of lime, and with alumina as aluminate of lime $^3CaO.\ SiO^3\ CaO\ Al^2O3$.

In the light burned cement there is no formation of aluminate of lime, simply a formation of bi-basic silicate of lime, magnesia and a small percentage of silicate of alumina which we will prove by the following analysis.

### ANALYSIS OF SHEPHERDSTOWN POTOMAC CEMENT

| | | | | | |
|---|---|---|---|---|---|
| Loss by calcination | 7.00 | | | | |
| Silica in combination | 27.00 | | | | |
| " not combined | 6.42 | | | | |
| Alumina | 10.04 | | | | |
| Oxide of iron | 6.00 | | | | |
| Lime | 32.24-2 | $CaO.\ SiO^2$ 49.51 = $SiO.^2$ | | | 17.27 |
| Magnesia | 9.59-2 | $MG^o.\ SiO^2$ 16.78 = " | | | 7.19 |
| | | | 66.29 | | |
| Alkalies | 0.50 | $SiO^2$ in combination with $CaO\ MG^o$ | | | 24.46 |
| Sulphuric Acid | 0.85 | " in combination with alumina and alkali | | | 2.32 |
| Loss | 0.66 | found by calculation | | | 26.78 |
| | 100.00 | found by analysis | | | 27.02 |
| | | Difference | | | 0.24 |

### ANALYSIS OF ROUND-TOP POTOMAC CEMENT.

| | | | | | |
|---|---|---|---|---|---|
| Loss by calcination | 7.00 | | | | |
| Silica in combination | 26.02 | | | | |
| " not combined | 2.00 | | | | |
| Alumina | 10 20 | | | | |
| Oxide of iron | 8.80 | | | | |
| Lime | 44.05) | | | | |
| Magnesia | 1.00) | —45.55 calculated as bi-basic silicate of lime—69.94 Silica | | | 24.39 |
| Alkalies | 0.50) | | | | |
| Sulphuric acid | 0.43 | in combination with alumina | | | 1.83 |
| | 100.00 | Silica found by calculation | | | 26.22 |
| | | Found by analysis | | | 26.02 |
| | | Difference | | | 0.20 |

## WATER

WATER-WORKS are to be built at Seville, Fla.

MANY of the prominent citizens are earnestly agitating the building of water-works in the near future.—Harper (Kansas) *Graphic*.

JANESVILLE, Wis., is to have water-works.

THE Carlyle Water Works Company, of Carlyle, Ill., has been incorporated to supply Carlyle with water.

THE Augusta Water Works Company, of Augusta, Ga., contemplate erecting a filtering machine.

THE Bedford Water Company, of Bedford, Pa., will at once advertise for bids for the construction of a new reservoir for their water works.

A. W. VAN VLIET, of Fishkill-on-the-Hudson, New York, invites correspondence with builders of water-works, concerning the supply of two towns with water.

THE Syracuse Water Company, of Syracuse, N. Y., are to extend their works and pipes, and will build an immense storage reservoir.

THE Louisville Water Company of Louisville, Ky., will erect a new pumping station. Jacob Bickle has the contract for building the embankment, for $15,500.

THE Hanover Water Company, of Wilkesbarre, Pa., has been incorporated to supply water to the town of Hanover, Pa.

THE Tampa Water Works Company, of New York City, was incorporated last week; capital $100,000.—Holly system.

MONTGOMERY, Ala., is to have a system of water works. Arthur H. Howland, Boston, has the matter in charge.

AN addition is to be built to the Utica Water Works at Utica, N. Y. Engineer C. F. Carpenter has charge of the work.

I. F. DORTCH, Goldsboro, N. C., is chairman of a committee on water-works, which are to be constructed in that town. Bids will be received up to January 1st.

THE Metropolitan Water Supply Company, of Newton, Iowa, has been incorporated to supply water to cities and towns in Iowa.

BONDS will be issued to the amount of $20,000 for the purpose of laying water-pipes in Campbell Highway, Troy, N. Y. Palmer H. Baermann, of Troy, has the matter in charge.

THE Connelsville Water Company, R. C. Greenland, superintendent, Connelsville, Pa., will at once build another reservoir and lay additional pipes. No contracts have as yet been let.

F. W. COLSTON and J. W. BROWN, Baltimore, Md., have bought the property and franchises of the Charlotte Water Works Co., Charlotte, N. C., and will improve and enlarge them.

AN artesian well is being sunk in Lafayette Square, New Orleans. A seven inch pipe has already been forced down over six hundred feet, and water has not yet been reached. The well will be sunk 2,500 feet if necessary to get a good supply of good water. The contractors are the American Well Works, Aurora, Ills.

THE Board of Water Commissioners of Detroit will lay 33 miles of iron pipe next year. Secretary Starkey, of the Water Board, will solicit bids, to be opened December 9, for 8,000 pieces of 4-inch pipe, 5,000 of 6-inch, 1,110 of 8-inch, 250 of 24-inch, and 325 of 30-inch pipe, to be laid next year. This will cost $80,000 or more.

THE suits brought by S. R. C. Mathews and R. D. Wood & Co., of Philadelphia, against certain parties for infringement of their patent for a hydrant with a "sliding frost jacket," brought originally in January 1873, but only decided (on a re-issue of their patent No. 10452, and dated Feb. 28, 1884) on Oct. 28, 1885, the court affirming validity of the patent and granting an injunction against parties infringing said patent. The rights of Messrs. R. D. Wood & Co. under this patent have been fully sustained by the decision.

THE Chester Pipe and Tube-Works, at Chester, Pa., resumed operations on the 23d ult., having been idle for two years.

THE Weiser, Col., ditch company will spare no expense to complete its canal the coming winter and spring. This ditch covers between 25,000 and 30,000 acres of the best desert land in Idaho. When the canal is made of sufficient capacity to supply plenty of water it will be valuable property.

ONE effect of the discovery and development of gas wells has been to put up the price of land in the region where they are found, and to break down the value of coal lands. Land in the neighborhood of Pittsburg, known to contain coal, can be had for $30 an acre, while gas privileges alone are bringing $5000 an acre.

CORRY, PA., November 25th.—Corry, situated in the midst of the greatest oil country in the world, and surrounded by an unlimited supply of natural gas, up to the present has made no effort to supply itself with gas for lighting and heating purposes. The Pennsylvania Natural Gas Company, of Warren, Pa., has secured the right of way and also the privilege of laying pipes in the city for the purpose of furnishing natural gas. The laying of the pipe will soon begin, and gas will be supplied in the near future.

SHARON, PA., Nov. 24.—Several representatives of the syndicate of capitalists organized at Franklin and Oil City, held a conference with leading citizens here yesterday, in regard to piping natural gas to this place. Arrangements will be completed in a few days. The mains will be laid a distance of forty miles, at a cost of $300,000, and $50,000 will be expended in piping the city. Smaller towns in the vicinity are to be supplied with branch lines. Iron men predict a revival of iron trade in Shenango Valley as soon as the new fuel is introduced.

CONEY ISLAND'S SEWERAGE.—At the meeting of the Gravesend Health Board, November 21st, R. V. Van Buren was appointed Consulting Engineer to the Board, and James I. Powers, Superindent of Construction. They will have charge of Coney Islan l's prospective sewerage system when that work is begun. Supervisor McKane was requested to name an engineer to make a topographical survey of the section to be sewered. Mr. McKane is heartily in favor of a complete sanitary transformation of the section between the Brighton Beach Hotel and Norton's Point. No attempt has ever been made to introduce a proper system of sewerage on this portion of the island.

THE town of Lenox, Mass., is in trouble with its sewage disposal. This town was one of the first to try the Waring system of disposal; the sewage flowing into a tank in a field remote from the town, whence the liquid portion is supposed to be carried off by porous tile drains into the soil. The increased use of the sewers has made this system inefficient; the tile drains are clogged by solid matter, and the system has become a nuisance. On being applied to, Col. Waring stated that this was one of the first places to test this system; he finds roof-water discharged into the sewers and suspects that vaults are connected therewith. He advises the addition of five Field flush-tanks, at $50 each; the relaying of 10,000 feet of distribution pipe and new connection with the tank outlet; the whole to cost $965. He waives his royalty claims of $200. This report was received at a thinly attended town meeting last week, and objection was made to trying any more experiments with the Waring system, in the light of their past experience. The report and subject has been referred to a committee which is to report on the first Monday in March next; the committee in the mean time to inspect the working of the Waring system in other towns.

LIVERPOOL ENGINEERING SOCIETY. The usual fortnightly meeting of this society was held on Wednesday, the 11th ult., at the Royal Institution, Colquitt street, Mr. W. E. Mills (president) in the chair. A paper by Mr. Thomas Duncanson, Assoc. M. Inst. C. E., entitled "Service Reservoirs," was read by the author. The author first referred to the comparatively small reservoirs required for regulating variations in the consumption of water, and obviating the inconveniences from accidents, and showed that under varying circumstances the service reservoir may properly fulfil its functions, with a capacity of from one to six days' supply. He then pointed out the desirability of covering service reservoirs, and proceeded to consider the subject under the heads of open and covered reservoirs. Open reservoirs, he stated, were usually constructed much on the same lines as storage reservoirs with earth-work embankments, rendered watertight by clay puddle. Covered reservoirs were dealt with under the heads of—(1) materials used to insure watertightness, (2) walls, (3) floors, and (4) roofs. In referring to the question of materials used to insure watertightness, the author recommended clay puddle for adoption when the foundation is on clay, Portland cement when it is on earth, gravel, or rock, and artificial asphalt when on rock. The principles on which the walls should be proportioned and the best formation of the floors were then dealt with. Referring to the construction of the roof and the methods of supporting it, the author pointed out the desirability of supporting it on brick, stone, or concrete arches, instead of columns and girders. In conclusion the cost of reservoir construction was considered, and it was stated that, although this varied much for different localities and sizes, an average price for open service reservoirs would be about 10s per 1,000 gallons capacity: and for covered service reservoirs about £4 5s per 1,000 gallons capacity.

A COMPANY has been organized under the name of the Barrington Water Company, to supply water to Barrington, R. I. Contracts will be made for laying pipes. Henry J. Steere, of Providence, R. I., has the work in charge.

GRANVILLE, N. Y.—A large force of men are at work ditching up North street towards the hill where the reservoir will be located. The village will issue $20,000 in bonds at 4 per cent. payable semi-annually, to extend the water-works.

## NEWS OF THE WEEK.

### Contracting.

**Enlarging Works.**—The Pencoyd Iron Works, Philadelphia, Pa., are enlarging their works.

**The Flynt Building and Construction Company,** Palmer, Mass., has contracted to put up buildings and stack 100 feet high, for J. T. Fay & Co., Blanchardville.

**Sea Wall.**—The contract for repairs to sea wall at Coaster's Harbor Island, R. I., has been awarded to J. V. Cotton, at $9,795.

**The Tropical Construction Company** has been organized at Tavares, Fla., by Alexander St. Clair-Abrams and others, to construct railroads, bridges, etc. Capital stock, $30,000.

**Building Contract Let.**—The State Board of Charities, of Topeka, Kan., has let the contract for the erection of the Orphans' Home at Atchison to Wright & Leeth, of Atchison, for $23,020.

**A Breakwater** that will cost several thousand dollars is to be built across the west end of Provincetown, Mass., harbor, from S. T. Nickerson's wharf to a point west of the oil works on Long Point.

**Light House.**—The lowest bidders for the work of erection and superstructure of Killick Shoal Light House, Va., were Messrs. Shaw & Hughes, of Cape May, N. J., their price being $3,946.

**R. R. Contract.**—The contract for the construction of the entire line of the San Antonio & Aransas Pass Railway from San Antonio to the Gulf was let November 24th, to Felton & Johnson. The road is to be finished by August 15, 1886.

**Court House.**—Scott county, Iowa, will probably build a court house next season. The commissioners of that county are now making a tour of inspection to Illinois and Indiana cities to obtain pointers. Their first business was to inspect the court house at Chicago.

**The Bridge Tunnel Company,** incorporated at Albany a short time ago, proposes to construct a tunnel from the junction of Flatbush and Atlantic avenues, Brooklyn, to the bridge. It is proposed to disregard street lines and buy all the property under which the tunnel passes.

**Burlington & Missouri R. R.**—The contract for an extension from Fairmont, Neb., to Geneva, has been let to John Fitzgerald. Mallory & Cushing have secured the contract for nearly forty miles of road from the present end of the Holdrege extension northwest. Work will begin on both contracts immediately, and will be vigorously pushed. It is said that the work on the Mallory & Cushing contract will be among the heaviest ever done in the State.

**The Chicago Forge & Bolt Works,** of Chicago, are building new works to occupy about eleven acres of ground. The entire equipment will cost in the neighborhood of $200,000. Side tracks are being put in by the Pittsburg, Fort Wayne & Chicago, Rock Island and Western Indiana railroads, making about a mile of track on eleven acres. The plant at South Chicago will be removed to the new works gradually, so as not to interfere with the regular course of business. An order for 1,500 tons of car axles has been booked, and 2,500 axles have been shipped this month.

**Italian Laborers Going South.**—Three hundred Italian laborers passed through Reading, Pennsylvania, November 28th, for Charleston, S. C. They are believed to be the first foreign laborers sent South from Eastern Pennsylvania, and hundreds are preparing to follow them to various southern states. They are promised $1.25 to $2 a day, and it is believed that the climate of the South will suit them better than that of the North. The indications are that a great exodus of Italians, Poles and Hungarians will take place from Eastern Pennsylvania this winter and that most of them will go South.

**Brooklyn Federal Building.**—A large force of men resumed work on the new Federal Building, Brooklyn, November 25th. The brick-work of the foundation is almost completed, and when the stone is placed in position, work on the superstructure will be begun. Superintendent Rutan said that with the present appropriation he would be able to complete the work to the second story, and as the contract had not been awarded for the iron beams he would be unable to proceed any further. From information conveyed to him he learned that Architect Bell would soon recommend an additional appropriation of $2,000,000.

**Cincinnati Pavements Let.**—Last week 122 bids were opened for paving nearly nine miles of streets in Cincinnati, Ohio. The Engineer's estimate was about $1,125,000; a hasty computation of the summary of bids opened shows that the lowest bids are probably not over $1,000,000. The Board of Public Works is enjoined, for the present, from awarding the contract, pending the decision of the Supreme Court on the Constitutionality of the Four Million Bill, from which it is to be paid: but the bids have been referred to Chief Engineer Danenhower for computation.

The following is a comparative statement of the principal items in the various bids, the bidding being on the cubic yard for crushed bowlders, grading, limestone, sand and concrete, by the lineal foot for curbs and crossings, and by the square yard for granite and pavement rolling.

| FOURTH STREET. | | STONE FOUNDATION. | | | | | | | | CONCRETE FOUNDATION. | | | | | | | | OTHER STREETS. | | | | | | | | CONCRETE. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATERIAL. | | E. J. McKeever. | | Frank Kirchner. | | Chas. M. Steele. | | Folz, Ashman & Co. | | Boyle & McMahon. | | W. A. Adams. | | W. H. Beard. | | Jas. Fenwald. | | Mich. J. Jady. | | M. J. Forbes. | | STONE FOUNDATION. | | F. H. Kirchner. | | Wm. Hussey. | | E. C. Boyce. | | Hy. McElfane. | | John O'Brien. | | Dreman and Schwartz. | |
| Crushed bowlders | Bowlders | 2.50 | 1.10 | 2.50 | 1.05 | 1.20 | .95 | 1.95 | 1.25 | 2.20 | 1.00 | 2.30 | 1.00 | 2.00 | 1.49 | 2.78 | 1.40 | 1.50 | 1.20 | 1.90 | 1.10 | Bowlders | 2.50 | 1.10 | 2.50 | 1.00 | 3.25 | 1.20 | 2.40 | 1.00 | 2.60 | 1.00 | 2.12 | 1.00 |
| Granite curbs | Curbs | 1.15 | 1.20 | 1.05 | .30 | .95 | 1.10 | 1.25 | 1.20 | 1.00 | 1.00 | 1.05 | 1.00 | 1.50 | 1.57 | 1.40 | 1.45 | 1.25 | 1.20 | .62 | .60 | Curbs | 1.15 | 1.00 | 1.10 | .90 | 1.20 | .47 | 1.05 | .43 | 1.00 | .25 | .95 | .80 |
| Granite crossings | Crossings | 1.20 | 1.20 | 1.10 | 1.00 | 1.10 | .56 | 1.20 | .50 | 1.00 | 27½ | 1.00 | .27 | 1.50 | .55 | .80 | 5.05 | .62 | 4.75 | .80 | .80 | Crossings | 1.20 | 1.00 | 1.20 | 1.00 | 1.20 | .47 | 1.00 | .43 | 1.00 | .25 | 3.25 | 4.65 |
| Grading | Grading | .75 | 1.20 | .75 | .30 | .56 | 3.75 | .50 | 3.75 | 27½ | 3.69 | .27 | 3.48 | 3.90 | 5.05 | 2.74 | .15 | .75 | .75 | 5.00 | 4.75 | Grading | .75 | .30 | .75 | .30 | 3.50 | .47 | 3.18 | 3.60 | 3.18 | 3.60 | .95 | .65 |
| Granite pavement | Granite | 3.80 | 3.95 | 3.15 | 3.95 | 3.95 | 3.75 | 3.95 | 3.75 | .04¼ | 5.16 | .03 | 5.00 | 4.00 | 6.05 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | Granite | 3.80 | 3.20 | 3.15 | 3.00 | 3.50 | 3.66 | 3.50 | 3.66 | 3.18 | 3.60 | 3.25 | 4.65 |
| Limestone and sand | Limestone | 1.35 | 1.35 | 1.50 | 1.50 | 2.10 | .07½ | 1.95 | .05 | 2.05 | .04¼ | 2.08 | .03 | 1.90 | 0.5 | 2.74 | .15 | 1.70 | .07½ | 1.80 | .03 | Limestone | 1.35 | 1.35 | 1.50 | 1.80 | 1.75 | .03 | 1.80 | .03 | 1.75 | .05 | 1.56 | .03 |
| Rolling | Rolling | .05 | .25 | .05 | .05 | .07½ | .05 | .05 | .05 | 1.15 | .04¼ | .05 | .03 | 1.30 | .05 | 1.50 | .07½ | 1.20 | .07½ | 1.50 | .05 | Rolling | .05 | .05 | .05 | .04 | .05 | .04 | .05 | .04 | .05 | .06 | .05 | .05 |
| Sand or gravel | Sand | 1.25 | 1.25 | .80 | .80 | 1.20 | .07½ | .75 | .75 | 1.15 | .04¼ | 1.30 | .03 | 1.30 | .05 | 1.50 | .07½ | 1.20 | .07½ | 1.50 | .05 | Sand | .75 | .05 | .75 | .05 | .75 | .05 | 1.50 | .05 | 1.60 | .05 | 1.95 | .05 |
| | Curbs | | 1.10 | | 1.05 | | .95 | | 1.25 | | 1.00 | | 1.05 | | 1.49 | | 1.40 | | 1.20 | | 1.10 | Curbs | | 1.00 | | 1.00 | | 1.20 | | 1.00 | | 1.00 | | 1.00 |
| | Crossings | | 1.20 | | 1.00 | | 1.10 | | 1.20 | | 1.00 | | 1.00 | | 1.57 | | 1.45 | | 1.25 | | 1.40 | Crossings | | 1.00 | | 1.00 | | 1.20 | | 1.00 | | 1.00 | | 1.00 |
| | Grading | | .75 | | .30 | | .56 | | .50 | | 27½ | | .27 | | .55 | | .80 | | .62 | | .60 | Grading | | .30 | | .30 | | .47 | | .43 | | .25 | | .80 |
| | Granite | | 3.80 | | 3.15 | | 3.95 | | 3.75 | | 3.69 | | 3.48 | | 3.90 | | 5.05 | | 4.75 | | 4.00 | Granite | | 3.20 | | 3.00 | | 3.66 | | 3.18 | | 3.60 | | 3.25 |
| | Concrete | | 5.00 | | 6.00 | | 5.73 | | 5.00 | | 5.16 | | 5.00 | | 6.00 | | 6.00 | | 4.75 | | 6.10 | Concrete | | 5.50 | | 4.25 | | 5.00 | | 5.25 | | 5.25 | | 4.65 |
| | Rolling | | .05 | | .05 | | .07½ | | .05 | | .04¼ | | .03 | | .05 | | .06 | | .03 | | .09 | Rolling | | .05 | | .05 | | .05 | | .06 | | .06 | | .05 |

**Bids for Bridge Iron.**—On December 1st, Bridge President Howell awarded the contract for furnishing steel and iron for the four arches to be completed in New York to the Phœnix Bridge Company for $17,577.45. The other bids were as follows: Post & McCord, $18,049.68; Charles O. Brown, $18,532.40; Wallis Iron Works $18,574.38; A. R. Whitney & Co., $18,663.08; J. B. & J. M. Cornell, $18,836.72; Pittsburg Bridge Company, $19,204.01; Penn Bridge Works, $19,466.37; Lindsay & Graff, $19,781.19; Passaic Rolling Mills, $20,174.71; Edgemoor Iron Company, $21,784.09; Cheney & Hewlett, $23,086.79; Keystone Bridge Company, $23,716.44. The estimates are based upon specifications requiring 314,820 pounds of steel girders and 209,880 pounds of iron beams. There will be four three story warehouses, with deep cellars, in the block B. The engineer's estimate of cost for the steel girders and iron beams was $20,900.

## Railroads, Bridges and Canals.

A new iron bridge is to be constructed at Wheeler, N. Y., by D. D. Wheeler, of that place.

**New Bridge.**—County Commissioner Alexander and Beatty, Mercer, Pa., have decided to build a new bridge over Welch's Run.

**Suspension Bridge.**—A company has been formed to build the Tennessee and Arkansas suspension bridge over the Mississippi river, at Memphis, Tenn.

**A New Iron Bridge** is to be placed over the Sacandago river. Commissioner Ramsay, Luzerne, Pa., has the matter in charge.

**A New Iron Bridge** will be built over the Poestenkill, Troy, N. Y. The city engineer, Mr. Fuller, has the matter in charge.

**New Bridge.**—The Consolidated Railroad will erect an iron truss bridge, to cost $20,000, at Grand street, New Haven, Conn.

**Railroad Survey.**—A corps of surveyors is running a line from Micanopy to Williston, Levy County, for the Florida Southern Railway.

**New Bridges.**—A new forty-foot iron bridge is to be built over Lee's River in Swansea, Mass. The chairman of the county commissioners has the matter in charge.

**Railroad Survey.**—A party of surveyors passed through Linden, N. J., November 30th, for the purpose of laying out the route for the new connecting railroad by which the Baltimore and Ohio R. R. Company proposes to reach tidewater.

**New Bridge.**—The Main Central Railroad Company will build a large new iron bridge across the Penobscot river at Orono, and also across the Mattawamkeag river, at Mattawamkeag.

**Highway Bridge.**—A bridge is to be erected across Burnham's canal, Milwaukee, Wis. Bids were received up to December 4th and the structure must be completed by April 1st, 1886.

**Missouri Pacific Extension.**—The survey of the Missouri Pacific Railroad to Red Cloud, Neb., has been completed. The proposed extension begins at Salem, Kan. The Red Cloud people are also figuring on an extension of the Rock Island road to that city.

**The Brooklyn Underground Railway Company** has withdrawn its opposition to the construction of the Kings County Elevated Road on Fulton street. All active opposition to such a plan is now almost at an end. The line will be extended from Hudson avenue down to Adams street, making a straight track from East New York to the City Hall, where it will make connections for the bridge.

**P. M. & C. R. R.**—A dispatch from Pittsburg states that General Manager Negley, of that city, has been in consultation with President Jewett, of the Chicago & Atlantic Railroad, on business relating to the construction of the Pittsburg, Marion & Chicago Railroad, incorporated at Columbus, O., a few days ago. It states further that engineers will be put to work on the line at once, and that by spring the line will probably be ready for location.

**Struck a Sink Hole.**—The contractors grading the Wisconsin Central line from Schleisingerville to Chicago have struck a sink hole just out of Schleisingerville, which has delayed track laying considerably. The hole is in the midst of a bog. It was thought when the survey was made that 5,000 yards of earth would raise the hole to the requisite grade. Already 50,000 yards of filling have been put in. It is believed that the bottom has been found.

**Kansas Railroads.**—INDEPENDENCE, Kan., November 23.—The surveyors have located seventeen miles of the Verdigris Valley, Independence and Western Railroad, from Leroy to Independence, and are pushing along as fast as possible, and will reach this city about December 21st. President Foster, of this road, will start the contractors to work this week at Leroy, grading and bridging the road.

The Independence and Southwestern road is being graded southwest from this city, and will build forty miles as fast as possible. When completed the division of the Southern Kansas Railroad will be moved here from Cherryvale.

**Cape Girardeau and Southwestern R. R.**—J. F. Brooks, Engineer of the Cape Girardeau and Southwestern Railway Company, is now at Bloomfield, Mo., with a corps of men surveying a line for a railroad from Brownwood, in the northern part of Stoddard county, through Bloomfield to a point on the Texas and St. Louis Railroad, at or near Malden, in Dunkin county. Mr. Brooks says the right of way on this road will be cleared this winter, and that grading will be commenced early in the spring. The people are much elated at the favorable prospect of a railroad at an early day. The citizens of Bloomfield are to take $20,000 in bonds, to be paid when the line reaches Bloomfield.—*Globe-Democrat.*

**Highway Bridge.**—A new iron bridge to replace the wooden one which has broken down near Peruville, N. Y., will be built at once. The trustees of Pennford have the matter in charge.

**Vandalia Extension.**—At a meeting of interested parties in Indianapolis, Indiana, November 22, it was determined to extend the Logansport Division of the Vandalia from South Bend to Benton Harbor, on Lake Michigan. Work will begin as soon as spring opens.

**Fall of a Bridge.**—At Troy, N. Y., a bridge over Wynant's Kill Creek fell, carrying with it, twenty feet below, four men who were at work repairing it. Henry Burger, of Albany, was injured internally. Theodore Goodrich and Patrick Fagan, of Albany, were seriously cut, and John Baynes was bruised. The bridge had been weakened by persons tearing away the supports or firewood.

**Corsicana and Sabine Pass R. R.**—A telegram was received at Corsicana, Texas, November 25, from Messrs. Whitney & White, of New Orleans, stating that they would close with that city on the terms submitted to Col. Hyatt a few days ago for the building of the Corsicana and Sabine Pass Railway, and that Col. Hyatt would be there in a few days to arrange preparatory measures to commence the work.—*Globe Democrat.*

**Muscle Shoals Improvement.**—Maj. W.R. King, engineer in charge of the Muscle Shoals improvement of the Tennessee river, says over two and a quarter millions have been spent, and $850,000 will now entirely finish the work. He has assurances from the leading members of the House that this amount will be allowed, and the great work completed.—Savannah, Ga., *Morning News.*

**A Motor Line.**—Rumors are current that certain individuals are interested in the building of a motor line from St. Paul to White Bear Lake. For the last two or three weeks surveyors have been busily engaged making out a route between these points via the west end of Lake Phelan, while one or two St. Paul parties have been as busily engaged buying up all the real estate in the vicinity of Elevator B and the foundry on Rice street in St. Paul.—Chicago *Tribune.*

**English vs. American Bridges.**—An English engineer (B. Baker), well known in railway circles, says that American bridge builders are, for bridges of all ordinary sizes, completely cutting the English builders out of the market for Canada and other colonies, and this is chiefly due to Board of Trade rules, which, instead of improving, have caused the depreciation of English bridges, by the use of the common material which will stand the four and five tons tensile and compressive strains.

**New Railroads in Nebraska.**—Manager Callaway of the Union Pacific Railroad says there will be much railroad building in Nebraska next year, and that the Union Pacific will keep up with the procession. Mr. Callaway also stated that branches would be built to every available point and through every section which would warrant the laying of tracks. The section of road from North Loup to Ord is the beginning of a branch that will eventually be pushed far into the northwestern portion of the State, and other branches will be constructed.

**The New Transcontinental Line.**—MILWAUKEE, Wis., Nov. 22.—A gentleman from North Wisconsin says that the new trans-Wisconsin railway line, the Sault Ste. Marie, has been brought from the west to a point in Price county within eighteen miles of a junction with the Wisconsin Central, and there is no doubt but that the road will, during the coming season, be completed to the Wisconsin River, a crossing of which will be made at some point in Lincoln county, probably near Rhinelander, on the Milwaukee, Lake Shore & Western. Construction work will be carried on this season until stopped by snow.

**The St. Lawrence Bridge.**—The contractors who have obtained the contract for the construction of the Canadian Pacific bridge across the St. Lawrence at Lachine, have already commenced their labors, and as a consequence, considerable activity prevails in the vicinity of the proposed structure. Blacksmith and carpenter shops are being erected on the north bank of the river below Lachine village. The construction of a temporary trestle work will be commenced in a few days, to enable material to be conveyed to the workmen working at the piers. Two of the latter will be constructed this winter, coffer-dams being called into requisition in order to secure proper foundations for the enormous structure. As soon as the ice moves out of Lake St. Louis next spring, the work will be carried on with vigor on both banks of the river. On the Lachine side the abutments and approaches will be constructed during the coming winter. Activity will also prevail at the Dominion Bridge works, the proprietors of which have secured the contract for the iron work. The caissons will be built this winter also. Enormous quantities of stone for the bridge are being taken out of the quarries at Terrebonne, St. Martin, Pointe Claire and other points.—Montreal *Star.*

**The Atlantic & Pacific R. R.** Directors have issued an order to contract for grading and bridging another section (the length of which is a little indefinite, but fifty or seventy-five miles probably) of the central division of their road, from Red Fork, I. T., westward into the cattle country, and on the proposed line to Albuquerque. Red Fork is four miles beyond the Arkansas River, at Tulsa, where a fine iron bridge will be completed before the year is out.

**Change of Gauges.**—The changing of the gauge on the leading Southern railroads next spring and summer will prove a blessing to several Chattanooga manufactories. It is usually the case during the dull season when there is but little business being done, to reduce the force of hands at some of the factories, and many barely keep in operation. The change of gauge on the roads will necessitate the purchase of a vast amount of railroad supplies, such as castings, nails, bar iron, spikes, fish plates, etc. Already several large contracts have been made with Chattanooga factories for supplies, one order being for forty-one car loads. Our manufacturers have been invited to bid on contracts from several of the largest systems in the South, and there is a good probability that Chattanooga will capture her share.—Chattanooga *Times.*

**Railroad Building.**—It is supposed by some that experience has stopped the building of competing railroads. But it is not so. Western lines are even now building competing roads with great energy, and at the same time are furiously "bulling" stocks in order to get money with which to get more roads. It never will be true that the construction of new competing lines can be prevented otherwise than by law, where unusual profits are secured by lines in existence. If combination should secure unusual profits, it would inevitably increase the building of competing lines, and all the evil consequences would result to the railway system and to the country, which excessive railway building involves. But if combinations should not secure larger profits, the less successful roads would quickly be obliged to abandon it in a desperate struggle to save themselves from bankruptcy.—*Commercial Bulletin.*

**Accident at the New Aqueduct.**—A terrible accident occurred November 28th, at a place called Merritt's Corner, N. Y., in Westchester county, near the line of the New York City and Northern Railroad. While some workmen were descending a shaft at the new aqueduct works, the guard slide caught when but a short distance from the top, throwing out one of the occupants of the car, named John Edwards. In his fall Edwards struck against a bucket, which was coming up the shaft, also containing several workmen. The concussion threw James Burke, Michael Doyle and an Italian—name unknown—from the car, and they, with Edwards, fell to the bottom of the shaft, a distance of 150 feet. Edwards, Burke, and Doyle were instantly killed, and the Italian sustained injuries that will probably prove fatal. His skull is fractured. Burke leaves a wife and child. Doyle was also a married man and leaves a family in Ireland. Edwards leaves a wife and child in some part of Pennsylvania.

**The New St. Lawrence Railway Bridge.**—The new St. Lawrence bridge across the St. Lawrence river at Caughnawaga, for the Canadian Pacific Railway, surveys for which were made in 1882 under the direction of Mr. P. A. Peterson, chief engineer of the bridge, is an established fact. The contract for the piers has now been awarded to Messrs. Reid & Fleming, and the iron work to the Dominion Bridge Co. The work to be undertaken at present comprises the completion of the line of the Atlantic & Northwest Railway, which is built as far as the Cote St. Luc road to grade upon the Caughnawaga side of the river. The grading across the valley by Lachine is very heavy and the embankments will be of an average height of 30 feet, and a mile in length, crossing by bridges over the Grand Trunk Railway (Lachine branch) Lower Lachine road, and the Lachine Canal, which latter will be spanned by a draw of 230 feet total length. The bridge across the great river will be comprised of the following spans: Three deep girders 80 feet long, eight spans of 242 feet center to center of piers, two spans of 209 feet ten inches center to center, and two spans across the steamboat channel of 408 feet each, making a total of 3,547 feet from the face of the abutment at the Lower Lachine road to the pier of the Caughawaga shore, the river at this point being about 3,300 feet from shore to shore. The ten short spans will be decked trusses and about 25 feet between the under side of the bridge and the water; the channel spans, however, will be built on the cantilever principle, giving a clear headway for vessels of 60 feet over the summer water, the train passing through these trusses. The bridge will be built almost entirely of steel, and will be, although light to the eye, immensely strong. The piers will be founded upon the bed of the river, which is rock, and will have substantial cutwaters to resist the ice shoves. The great point gained at this particular site is the shallowness of the water, there being only three piers of any depth. The through line from Toronto via Smith's Falls will join this track on the top of the high ground by Blue Bonnets, after crossing the Ottawa, near St. Annes, and passes close to St. Genevieve, this bridge being destined to become the great thoroughfare from the Atlantic to the Pacific.—Montreal *Gazette.*

**The Wyandotte and Northwestern.**—Mr. W. B. Knight, Chief Engineer of the Kansas City, Wyandotte, Nebraska and Northwestern, speaking of the survey, said: "We have completed the preliminary line to Holton, a distance of eighty miles. The heaviest grade we have yet found is 68 feet, and I think I can reduce it to 50 feet on the location. The line is direct and the grade generally low, and will require comparitively light work. I shall make my estimate on the first 100 miles early in next month and shall have reached Seneca, 115 miles from Kansas City, by December 1. A line will be run to Hastings with a branch to Pawnee City. Whether a survey will be made to Beatrice depends upon the future action of the directors.—Kansas City *Times*.

**New Wisconsin Roads.**—From all appearances Wisconsin is to have a bigger boom in railroad building during the coming year than it has experienced for many years. The new roads and extensions to be constructed during 1886, so far as learned are as follows:

Milwaukee & Northwestern—Extension north through Michigan to connect with the Ontonagon & Brule River, 110 miles, and also from Forest Junction to Sturgeon Bay, sixty miles.

Dalrymple Road—North from Bayfield to the Indian reservation, 6 miles; then Southwest to Stillwater, 130 miles.

Merrill & Abbottsford—From Abbottsford northeast to Merrill, 40 miles.

Milwaukee, Peoria & Western—From Milwaukee southwest to Delevan, 40 miles.

Minneapolis, Sault Ste. Marie & Atlantic extension 100 miles.

Marshfield Road, known as Hile's Route—From Neillsville to Marshfield, 20 miles.

Minneapolis & St. Louis—From St. Croix Falls to Superior City, 100 miles.

Wisconsin Central—Extension from Waukesha to Milwaukee, 20 miles.

Menominee Falls & Western—Fourteen miles.

This makes a total of about 650 miles, which will probably be increased by the extensions of the Northwestern and the Milwaukee & St. Paul lines to nearly 1,000 miles.—St. Paul & Minneapolis *Pioneer Press*.

**Tile Making at Minimum Cost.—New Bridges.—Macadam Road Contracts.—Lighting Contracts.—Natural Gas.—Water Works.—New Jail.—Drainage in Ills.—R. R. Extension.—Illinois Coal.**

Special Correspondence ENGINEERING NEWS.

As illustrating the large way in which they do things out West, we note that a man, who owns a large body of land in Ford county, Ills., is proposing to make tile at a minimum cost next year. He proposes to economize in the handling. He will have his mill at the top of a little grade, down which small cars will run of themselves and carry the green tile toward the kiln and sheds combined. Enough cars will be provided so that the tile can be "backed up" right from the cars, and be allowed to dry in the kiln, which will be large enough to contain the summer's work. Only one kiln will be burned per year, and that late in the fall. When burned, one wall of the kiln will be torn down to get at the tile, and the wall moved around to the other side to repeat the operation for another year. He even hopes to float them, at least part way, to their destination in a flat-boat on the big ditch which is the outlet for the tile drains.

The Smith Bridge Company, of Toledo, Ohio, is putting in an iron highway bridge south of Sidney, Ills.

The Commissioners of Ripley Co., Ind., will open bids at Versailles on December 8th, for the construction of eight miles of macadamized road running out from Versailles. The contract will be let in mile sections for the road complete, including the furnishing of material, constructing bridges, culverts, side ditches, etc.

The Shelbyville, Ill., Water and Electric Light Co. has just been organized. The directors have been instructed to let the contracts for the necessary buildings.

Pekin, Ills., has just completed a Jenny electric-light plant.

A natural gas company has been incorporated in Urbana, Ills., to furnish that place with natural gas for illuminating and heating purposes, from a well six miles northeast.

Work has been suspended for the winter on the Lima, O., reservoir. The Hillsdale, Michigan, and Ravenna, Ohio, Water Works will be completed and pumps started in two or three weeks. The above works have all been constructed after the plans and under the supervision of the well known hydraulic engineer, J. D. Cook of Toledo, O., who also is now preparing designs for water works at Anderson, Ind., work to be let out this season, and who also has two other small cities in prospect for public water supply.

The Trustees of Jefferson, Ills., have decided to erect a new jail.

Pollard, Goff & Co., contractors for the Lake Fork ditch in Piatt Co., Ills., have received a supplemental contract to increase the width by 4 feet of the part already excavated, and extend the ditch three miles farther. The price was 14c.

The Indianapolis *Journal* says that it is quite probable that the C., I., St. L. & C. will, the coming year, lay a track of their own between Lafayette and Templeton. They now run over the Lake Erie & Western, the distance being eighteen miles. By cutting cross lots, as the saying is, the C., I., St. L. & C. can reduce the distance to fourteen miles, and not be at the mercy of the Lake Erie & Western people.

Frankfort, Ind., has a large force employed in laying pipes for the new gas and water companies.

The Decatur, Ills., Coal Company have unexpectedly struck a 5 foot vein of good coal at 608 feet; only a few weeks ago they found a 4 foot vein at 548 feet in the same shaft. This will help a little to revive the enthusiasm for digging for coal in that part of the State; the failures at Sidney, Tuscola, and Sadorus had been disheartening. Locally it is claimed that the coal area of Illinois extends over three-fourths of the entire State, containing about one-seventh of all known coal in North America, and producing yearly about 9,000,000 tons. B.

## Recent Patents.

**Device for Arresting Locomotives and Cars.**—*Maximilian F. Bonzano, Philadelphia Pa.* A buffer stop having the vertical posts attached to a shoe bearing on the rail; the posts can be tilted back until a lever rests upon the shoe; the object being to offer a gradual resistance to impact. No. 330,671.

**Revolving-Tower System of Fortifications.**—*Theodore R. Timby, Nyack, N. Y.* A revolving battery-tower has a sighting tower from which the guns are trained. A central well, not connected with the gun floor, contains the sighting and firing mechanism. The guns are arranged radially in the tower. Outside moveable shields are also supplied. Nos. 330,637 638 to 330,642.

**Track Cleaner.**—*Lyman Morgan, Port Washington, Wis.* The plow has three vertical rotating discs with cutters, arranged in a semicircle; the snow being discharged from the sides of the machine. No. 330,725.

**Tunnel Excavator.**—*Charles C. Quinn, Fargo, Dak.* A frame carries the excavators arranged diagonally to the line of the tunnel. The drilling bar is worked by levers from a steam or compressed air cylinder. Flange cutters are arranged diagonally below the frame. No. 330,617.

# Market Report of Engineering Materials.

**New York, December 3, 1885.**

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

### IRON.

| | | | |
|---|---|---|---|
| STRUCTURAL IRON. | | | |
| Angles | | 1.95 @ | 2.00 |
| Tee | | 2.25 @ | 2.35c. |
| Beams and channels American | | 3.0c. @ | |
| Tank | | 2. @ | 2.1c |
| Shell | | 2.4c. @ | 2.5c |
| Steel plates, Tank | | 2½c. @ | |
| WROUGHT-IRON PIPE., PITTSBURGH. | | | |
| Butt welded, black | Discount | 42½ @ | 45 |
| " " galvanized | " | 32½ @ | 35 |
| Lap welded black | " | 60 @ | 62½ |
| " Galvanized | " | 45 @ | 42½ |
| Boiler tubes | " | 55 | |
| RAILS. | | | |
| Steel (large lots at mill) | | 33.50 @ | 35.50 |
| Old rails | | 18.50 @ | 20.50 |
| Old rail steel | | 19.00 @ | 20.00 |
| R R. spikes | | 2.10 | |
| R R. splice-plates | | 1.75 | |
| R R. Track Bolts Square Nuts | | 2.75 | |
| Barb-wire fencing, galvanized | | | 4.50 |
| " painted | | | 3.50 |
| Corrugated iron | | | |
| Nails | | | |
| Iron, per keg | | 3.25 | |
| Steel do. | | 3.35 | |

### METALS.

| | | |
|---|---|---|
| COPPER. | | |
| Lake Superior | 11.10 @ | 11.51 |
| Other Brands | 10.00 @ | 10.20 |
| LEAD. | | |
| Com. Domestic | | 4.75 |
| Lead Pipe | .05¾ | |
| Tin-Lined Lead Pipe | .15 | |
| Sheet Lead | .06¾ | |
| ZINC. | | |
| Sheet | 5.35 @ | 5.55 |

### BRICK.

| | | |
|---|---|---|
| Cargoes afloat) | | |
| Haverstraw per M. | $5.75 @ | 6.25 |
| Fishkill | | |
| Up-River | 5.50 @ | 6.12½ |
| Jerseys | 5.00 @ | 5.75 |
| Long Island | | |
| " pale | 2.75 @ | 3.50 |
| FRONTS. | | |
| Croton red | 11.00 @ | 14.00 |
| " dark | 11.00 @ | 14.00 |
| " brown | 10.00 @ | 13.00 |
| Philadelphia pressed | 24.00 @ | 25.00 |
| Trenton " | 24.00 @ | 25.00 |
| Baltimore " | 37.00 @ | 41.00 |
| Buff " | 33.00 @ | 35.00 |
| Enameled English | 65.00 @ | 130.00 |
| " American | 85.00 @ | 120.00 |
| Fire brick | 25.00 @ | 45.00 |

### CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

| | | |
|---|---|---|
| BAETJER & MEYERSTEIN: | | |
| Hanover Port and | $2.60 @ | $2.65 |
| BELLONI & Co.: | | |
| Hemmoor "Crown" brand | | 2.50 |
| JAMES BRAND: | | |
| K. B. & S. | 2.55 @ | 3.00 |
| BROOKS, SHOOBRIDGE & Co. | 2.45 @ | 2.60 |
| HOWARD FLEMING: | | |
| Gibbs' English Portland, 400 lbs. | 2.65 @ | 2.90 |
| K. B. & S. " | 2.75 @ | 2.95 |
| Stettiner, German | 2.65 @ | 2.85 |
| Lagerdorfer, " | 2.45 @ | 2.75 |
| Fieve, A 1, Belgian | 2.35 @ | 2.50 |
| Roman | 2.75 @ | 3.00 |
| Keene's Coarse | 4.75 @ | 5.50 |
| " Fine | 7.75 @ | 8.50 |
| " Superfine | 8.50 @ | 10.00 |
| FISHER, ERSKINE W.: | | |
| Stettin (German) Portland Cement | $2.40 @ | 2.75 |
| GABRIEL & SCHALL: | | |
| Vorwohler "Lion" | 2.65 @ | 3.10 |
| HUDSON RIVER CEMENT Co. Rosendale | | 1.10 |
| JOHNSON & WILSON: | | |
| Saylor's American Portland | 2.15 @ | 2.40 |
| LAWRENCE CEMENT Co.: | | |
| Hoffman Rosendale | | |
| LESLEY & TRINKLE, Philadelphia, Pa.: | | |
| "Giant" Portland | 2.20 @ | 2.40 |
| Improved "Union" | 1.25 @ | 1.50 |
| Union | 1.10 @ | 1.20 |
| MARCIAL & Co.: | | |
| J. B. White & Bros. Coarse | 4.50 @ | 5.00 |
| " Fine | 8.00 @ | 10.00 |
| " Portland | 2.45 @ | 2.85 |
| NEW YORK CEMENT Co.: | | |
| Rosendale | | 1.20 |
| N. Y. & ROSENDALE CEMENT Co.: | | |
| Rosendale, "Bridge" brand | | 1.10 |
| SINCLAIR & BABSON: | | |
| Alsen's Portland | 2.45 @ | 2.75 |
| K. B. & S. | 2.35 @ | 2.60 |
| STANDARD CEMENT Co. | | |
| E. THIELE: | | |
| Dyckerhoff | 2.90 @ | 3.25 |
| UNITED STATES CEMENT Co.: | | |
| Windsor | 1.00 @ | 1.10 |
| Standard | | 1.15 |
| Cable's Portland | 2.15 @ | 2.40 |
| UNION AKRON CEMENT Co.: | | |
| Akron "Star" brand | | |

### ASPHALT.

| | | |
|---|---|---|
| Prices range per ton | $15.00 @ | 20.00 |
| According to quantity or brand, and whether taken from vessel or store. | | |

### LIME.

| | |
|---|---|
| Rockland common per bbl | 1.00 |
| " finishing | 1.20 |
| State, common | .90 |
| " finishing | 1.10 |
| Kingston, ground | 1.00 |
| Add 25c. to above figures for yard rates. | |

### STONE.

*Cargo rates at New York.*

| | | |
|---|---|---|
| Amherst freestone, No. 1 per cub. ft. | 0.90 @ | 95 |
| " " No. 2 " | 0.75 @ | 0.80 |
| " " light drab " | 0.80 @ | 0.95 |
| Berlin " in rough " | 0.75 @ | 1.00 |
| Berea " " | 0.75 | |
| Brown stone, Portland, Ct. " | 1.00 @ | 1.30 |
| " Belleville, N. J. " | 0.75 @ | 1.25 |
| Granite, rough | 0.60 @ | 1.25 |
| Common building stone per load | 2.00 @ | 3.00 |
| Base stone, from 2½ to 6 ft. lengths, per lin. ft. | 0.40 @ | 3.00 |

### SLATE.

| | | |
|---|---|---|
| Purple roofing per square | 6.00 @ | 7.00 |
| Green " | 6.00 @ | 7.00 |
| Red " | 15.00 | |
| Black Penna. (at New York) " | 4.50 @ | 5.00 |

### LUMBER.

Prices for yard delivery in New York.

| | | |
|---|---|---|
| PINE, Common box per M. | 18.00 @ | 20.0 |
| " Choice " | 65.00 @ | 70. |
| Tally plank, 1¼ in. 10 in. dres'd, each. | .44 @ | .50 |
| Tally boards, dressed com. " | .28 @ | .30 |
| SPRUCE, Boards dressed " | .25 @ | .28 |
| Plank, 1¼ in " | .28 @ | .30 |
| " 2 in. " | .38 @ | .40 |
| " 2 in. dressed " | .43 @ | .45 |
| Timber per M. | 20.00 @ | 22.00 |
| HEMLOCK, Boards each. | .18 @ | .20 |
| Joist, 2¼ × 4 to 4 × 6 in | .16 @ | .44 |
| OAK per M. | 55.00 @ | 65.00 |
| CYPRESS 1, 1¼, 2 and 2½ in " | 35.00 @ | 40.00 |
| YELLOW PINE, Girders " | 25.00 @ | 30.00 |
| Dressed flooring " | 28.00 @ | 35.00 |
| SHINGLES, Extra shaved pine, 16in. " | | |
| " sawed 18 in. " | 5.75 @ | 6.00 |
| LATH, Cargo rate " | 2.30 | |

### PAINT.

| | | |
|---|---|---|
| Lead, white, American dry per lb | .04¾ @ | .05 |
| " " in oil pure " | .05¾ @ | .06 |
| English, B. B. in oil | .08¾ @ | .08¾ |
| Red, American | .05¾ @ | .05½ |
| Litharge " | .05 @ | .05½ |
| Venetian red, American " | .01 @ | .01¼ |
| Indian red " | .05 @ | .10 |
| Vermillion, American lead " | .11 @ | .11¼ |
| Paris green " | .15 @ | .20 |
| Umber, Amer. raw and powdered per lb. | .01¼ @ | .01¾ |
| Drop black, Amer. | .07 @ | .13 |
| " " Eng. | .11 @ | .13 |
| Chrome green | .05 @ | .20 |
| Oxide zinc, American | .03¾ @ | .04 |
| " French | .06¼ @ | .06¾ |